



AGRICULTURAL RESEARCH INSTITUTE
PUSA

The Journal

OF THE

Ministry of Agriculture

VOL. XXVII.

(APRIL, 1920, TO MARCH, 1921.)



LONDON:
PRINTED UNDER THE AUTHORITY OF HIS MAJESTY'S STATIONERY OFFICE
AND PUBLISHED BY THE MINISTRY OF AGRICULTURE AND FISHERIES.
WHITEHALL PLACE, LONDON, S.W.1.

SUPPLEMENTS TO THE JOURNAL OF THE MINISTRY OF AGRICULTURE

No. 1.—REPORT ON AGRICULTURAL EDUCATION IN THE UNITED STATES	JAN., 1908
No. 2.—THE FOOD OF SOME BRITISH BIRDS	DEC., 1908
No. 3.—REPORTS ON THE WORK OF THE INTERNATIONAL AGRICULTURAL INSTITUTE ...	APRIL, 1910
*No. 4.—WHEAT: PAPERS READ AT A MEETING OF THE BRITISH ASSOCIATION AT WINNIPEG, 1909	JUNE, 1910
No. 5.—INFLUENCE ON THE PRODUCTION OF MUTTON OF MANURES APPLIED TO PASTURE ..	JAN., 1911
No. 6.—REPORT ON THE WORK OF THE INTERNATIONAL AGRICULTURAL INSTITUTE ...	JULY, 1911
*No. 7.—THE INTERPRETATION OF THE RESULTS OF AGRICULTURAL EXPERIMENTS	NOV., 1911
*No. 8.—REPORT ON THE ISLE OF WIGHT BEE DISEASE	MAY, 1912
No. 9.—NOTES ON KERRY WOODS, ILLUSTRATING METHODS OF COLLECTING AND UTILISING INFORMATION FOR A FOREST SURVEY ..	AUG., 1912
No. 10.—FURTHER REPORT ON THE ISLE OF WIGHT BEE DISEASE	JULY, 1913
No. 11.—THE CORRELATION BETWEEN THE PERCENTAGE OF MILK FAT AND THE QUANTITY OF MILK PRODUCED BY AYRSHIRE COWS	AUG., 1913
No. 12.—REPORT ON THE POSSIBILITY OF REVIVING THE FLAX INDUSTRY IN GREAT BRITAIN ...	JAN., 1914
No. 13.—SEED CONTROL STATIONS ON THE CONTINENT	AUG., 1914
No. 14.—REPORT ON THE POULTRY INDUSTRY IN WALES	OCT., 1915
No. 15.—REPORTS ON THE FOOD OF THE ROOK, STARLING AND CHAFFINCH	MAY, 1916
No. 16.—I. SOME ASPECTS OF THE DAIRYING INDUSTRY OF ENGLAND AND WALES II. THE COST OF MILK PRODUCTION ..	SEPT., 1916
No. 17.—GRASS LAND AND PLOUGHED LAND	MAY, 1917
No. 18.—THE CULTIVATION, COMPOSITION AND DISEASES OF THE POTATO	MAR., 1919
No. 19.—REPORTS ON THE KEEPING AND CARRIAGE OF MILK IN VENTILATED AND UNVENTILATED MILK CHURNS RESPECTIVELY	DEC., 1919
No. 20.—SEED TESTING DURING 1919-20. THIRD ANNUAL REPORT OF THE OFFICIAL SEED TESTING STATION OF THE MINISTRY ...	FEB., 1921

CONTENTS.

NOTES—	PAGE
The Future of Agricultural Machinery—Development of Agricultural Machinery—The Productiveness of the New Arable—Demonstration Farm in Norfolk	1
Cultivation of Land by County Executive Committees—Land Drainage—The Cultivation of a Moor in Cornwall	5
Cost of Butter Production—Whey and Dairy By-Products—Increased Milk Production in Cornwall—Production of Grade A Milk—Electro-pure Process of Treating Milk	11
The Pig Industry—Poultry and Eggs—Egg-Laying Competition of the Northern Utility Society—Tractor Trials, 1930	16
Shoddy as Manure: Danger of Anthrax—Village Organisation—The Value of Seaweed as Manure—Control of Potatoes	21
Smut Diseases of Wheat, Barley and Oats—The Wheat Bulb Fly—Wart Disease of Potatoes—Insect Pests and Plant Diseases—Composition of Linseed Grown in Scotland	23
FEEDING STUFFS FOR MAY. <i>From the Animal Nutrition Institute, Cambridge University</i>	31
IMPORTS AND EXPORTS OF FEEDING STUFFS AND FERTILISERS	34
POTATO GROWING	35
MANURES FOR MAY. <i>From the Rothamsted Experimental Station</i>	37
POTASH FERTILISERS	40
NITRATE OF LIME: ITS MANUFACTURE AND USE. <i>G. A. Cowie, M.A., B.Sc., A.I.C.</i>	43
THE COMPOSITION OF POTATOES IMMUNE FROM WART DISEASE. <i>E. J. Russell, D.Sc., F.R.S.</i>	49
A WOMAN'S IMPRESSIONS OF A DANISH SMALL HOLDING. <i>Bertha M. Bayne</i>	52
FRENCH AGRICULTURAL SOIL MAPS. <i>Lt.-Col. L. Tebbutt</i>	57
WILD WHITE CLOVER: ITS VALUE IN THE FORMATION OF PASTURES... ..	60
THE ESTABLISHMENT OF VILLAGE INDUSTRIES. <i>Sir John L. Green</i>	62
PRESERVING GREEN FODDER: AN INEXPENSIVE TRENCH SILO. <i>A. W. Oldershaw, M.B.E., B.Sc.</i>	65
AIR POLLUTION BY COAL SMOKE. <i>A. G. Ruston, B.A., B.Sc., M.Sc.</i>	69
DECAY IN POTATO CLAMPS DUE TO BLACK-LEG. <i>S. G. Paine and C. M. Haenseler</i>	78
IDEAL HOMES EXHIBITION—THE MINISTRY'S MODEL ALLOTMENT	81
AGRICULTURE ABROAD	85
Reclaiming Heath Land in Denmark—Settling Ex-Service Men in New South Wales—Improving Grass Land in Bavaria.	
Questions in Parliament	89
Notices of Books	90
Sugar Beet Growing in England	92
Foot-and-Mouth Disease	92
Rabies	93
Agricultural Executive Committees and Cultivation of Land Orders	93
Poultry and Egg Prices	93
Price of Sugar for Bee-feeding	98
Additions to the Library	94
Selected Contents of Periodicals	95

Any of the Articles in this Journal may be reproduced in any registered newspaper or public periodical without special permission, provided that the source is acknowledged in each case.

The Ministry do not accept responsibility for the views expressed and the statements made by contributors, nor for any statements made in the advertisement columns of this Journal.

TURNER'S CRUSHING AND GRINDING MILLS

FOR THE
ESTATE,
FARM
STABLE ETC.



Combined Crushing
and Grinding Mill.

Two Processes in
One Mill.

The most dependable
Mills on the market
for dealing with all
kinds of grain.

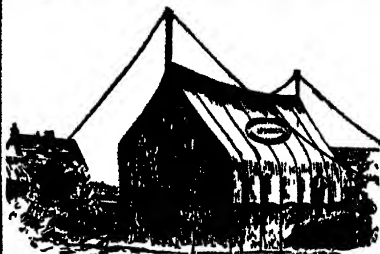
Catalogues free
on application.

E.R. & F. TURNER, L^{TD} (SHE) IPSWICH.

"CERES" RICKCLOTHS

BEST QUALITY AND
WORKMANSHIP THROUGHOUT.

Double Sewn Seams, Long Cords.



"The most satisfactory in the Market."

Illustrated Price List Post Free on
application to the Manufacturers:—

J. RANDS & JEKELL

Dept J. IPSWICH

RICK CLOTH, STACK SHEET
AND WATERPROOF COVER
MANUFACTURERS TO H.M. THE KING.

USE

The Creosoted Stave

NORFOLK SILO

and produce

MILK under 1/- per
gallon.



Particulars and Prices of—

JEWSON & SONS, L^{TD}

Head Office—NORWICH.

CONTENTS.

NOTES—	PAGE
April—Summer Application of Basic Slag to Pastures—Aisble Dairy Farming in North Wales—Grass Seed Mixtures and Temporary Leys	97
Co-operative Cheese-making—Open Air Shelters for Pigs—Instruction in Poultry Keeping—Education in the Use of Agricultural Machinery	103
Drainage of the River Lugg—Equipment of Small Holdings—Eradication of Bracken	109
Export of British Live Stock—Sugar for Fruit Preserving—Cost of Control of Food Supplies—Lights when Driving Animals at Night	112
New Duties on Agricultural Vehicles	112
MANURES FOR JUNE. <i>From the Rothamsted Experimental Station</i>	116
FEEDING STUFFS FOR JUNE. <i>From the Animal Nutrition Institute, Cambridge University</i>	118
FARMING ON BRECK-LAND IN NORFOLK. <i>S. L. Bensusan</i>	122
THE ACCOUNTS OF A HAMPSHIRE FLOCK IN 1918-19 <i>Sir Daniel Hall, K.C.B., F.R.S.</i>	126
OUR NATIONAL FOOD SUPPLY LIMITS OF SELF SUPPORT	133
THE TECHNIQUE OF CROSS-FERTILISATION IN POTATOES. <i>R. N. Sulaman, M.A., M.D.</i>	138
SOCIAL SERVICE IN RURAL AREAS. <i>Sir Henry Row, A.C.B.</i>	145
VILLAGE INSTITUTES AS AN AID TO RURAL EDUCATION	152
LIMING IN HEREFORDSHIRE AN IMPORTANT LOCAL INDUSTRY <i>John Porter, B.Sc.</i>	157
FARM ACCOUNTS, PROFITS, AND COSTS. <i>H. G. Howell, F.C.A.</i>	162
IMPRESSIONS OF A VISIT TO DENMARK IN 1919. <i>S. Emily Matthews</i>	172
THE MANAGEMENT OF BULLS	178
AGRICULTURE ABROAD	181
“Farmers’ Week” in Missouri—Agricultural Education in Canada—Agricultural Credit in Alsace-Lorraine	185
Questions in Parliament	188
Notices of Books	190
Manurial Values of Various Farm Foods	192
Weather Forecasts for Farmers	192
Foot-and-Mouth Disease	192
Rabies	192
Leaflets issued by the Ministry	193
Names and Routes of the Super, King’s, and Ministry’s Premium Stallions	193
New Duties in respect of Agricultural Vehicles	194
National Agricultural Examination Board	194
Additions to the Library	195

Any of the Articles in this Journal may be reproduced in any registered newspaper or public periodical without special permission, provided that the source is acknowledged in each case.

The Ministry do not accept responsibility for the views expressed and the statements made by contributors, nor for any statements made in the advertisement columns of this Journal.

TURNER'S CRUSHING AND GRINDING MILLS

FOR THE
ESTATE,
FARM
STABLE ETC.



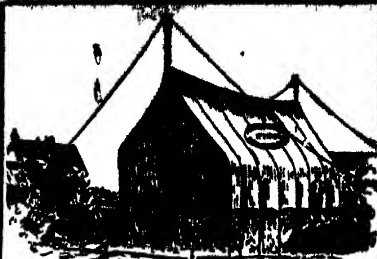
Combined Crushing
and Grinding Mill.

Two Processes in
One Mill.

The most dependable
Mills on the market
for dealing with all
kinds of grain

Catalogues free
on application.

E.R. & F. TURNER, LTD. IPSWICH.



"THE MOST SATISFACTORY
IN THE MARKET"

Is one of the descriptions given to

"CERES" RICKCLOTHS

by users, and confirmed by the demand - which
increases annually

All made with double-sewn seams.
Fitted with best quality long cords.

Illustrated Price List Post Free
from the Sole Manufacturers. -

J. RANDS & JEKELL

Dept. J. IPSWICH

RICK CLOTH, STACK SHEET
AND WATERPROOF COVER
MANUFACTURERS TO H.M. THE KING.

BEEF !!

Cost of production
reduced **75%**

by the Creosoted Stave

NORFOLK SILO.



Particulars and Prices of -

JEWSON & SONS, LTD.

Head Office - NORWICH.

CONTENTS.

NOTES OF THE MONTH—	PAGE
<i>The New Agriculture Bill—The Advantages of Agricultural Shows—Improvement of Grass Land: Local Demonstrations—Acreage and Live Stock Returns—Farm Power Problems—Standardisation of Agricultural Machinery</i>	197
<i>The Great Eastern Railway Demonstration Train—The Progress of Women's Institutes—Increase in the Value of Grants payable to Societies under the Live Stock Scheme</i>	205
<i>Seed-borne Diseases of Cereals: Possible Control by Dry Heat—1919 Potato Trials in East Sussex—Prevention of Wart Disease in Lincolnshire—Potato Blight: Uselessness of Seed Dressings—Fruit Preserving: An Experimental School</i>	209
<i>Experimental Cottage Building—Land Reclamation at Wainfleet—Effect of Exports on Supplies of Basic Slag—Farm Labourer's Wage: Deposition to Minister of Agriculture</i>	216
<i>The Inclosure Acts and Tithe Acts: Exchanges of Lands—Rat Destruction—Rats and Mice (Destruction) Act, 1919: Some Simple Suggestions—Facilities for Map Inspection at the Ministry of Agriculture</i>	220
<i>Notes on Poultry Feeding: From the Harper Adams Agricultural College</i>	224
AGRICULTURE DURING TWO GREAT WARS: 1793-1815 AND 1914-1918. <i>The Rt. Hon. Lord Ernle, M.V.O.</i>	227
THE NATIONAL ASPECTS OF THE CASE FOR INCREASING THE SUPPLIES OF BASIC SLAG. <i>Sir Thomas Middleton, A.B.E.</i>	241
THE "ROYAL'S" WAR RECORD. <i>J. P. Goodwin.</i>	250
PROFIT AND LOSS SHARING IN AGRICULTURE. <i>J. Wyllic, B.Sc., N.D.A. (Hons.)</i>	254
THE ALLOTMENT MOVEMENT IN ENGLAND AND WALES	262
SOME FEEDING EXPERIMENTS WITH DRIED BLOOD. <i>L. F. Newman, Dip. Agric. (Camb.).</i>	266
THE STUDY OF RURAL ECONOMY AT OXFORD. <i>S. L. Bensusan</i>	272
THE COMPOSITION AND FEEDING VALUE OF SILAGE	277
POTATO SPRAYING TRIALS IN THE CAMBRIDGESHIRE FENS, 1919. <i>F. R. Petherbridge, M.A.</i>	282
Potato Leaf-curl	287
Profitable Apples for Market	290
Questions in Parliament	296
Prices of Ground Basic Slag, 1920-21	296
Leaflets issued by the Ministry	298
Wart Disease of Potatoes: Free Inspection of Crops	299
Foot-and-Mouth Disease	299
Rabies	299
Weather Forecasts for Farmers	300
Fream Memorial Prize	300
New Chairman of Agricultural Wages Board	300
May Journal: Erratum	300

Any of the Articles in this Journal may be reproduced in any registered newspaper or public periodical without special permission, provided that the source is acknowledged in each case.

The Ministry do not accept responsibility for the views expressed and the statements made by contributors, nor for any statements made in the advertisement columns of this Journal.

TURNER'S CRUSHING AND GRINDING MILLS

FOR THE
ESTATE,
FARM
STABLE ETC.



Combined Crushing
and Grinding Mill.

Two Processes in
One Mill.

The most dependable
Mills on the market
for dealing with all
kinds of grain.

Catalogues free
on application.

E.R. & F. TURNER, L^{TD} IPSWICH.

YOUR RICK IS SECURED

against damage by wet

IF YOU USE

" CERES " RICKCLOTHS

"The Most Satisfactory in the Market."



Rot Proof.

Quality :	J	K	L	H	M
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
8 x 6 yds.	7 4 0	8 8 0	9 12 0	10 16 0	12 0 0
8 x 8 "	9 12 0	11 4 0	12 16 0	14 8 0	16 0 0
10 x 8 "	12 0 0	14 0 0	16 0 0	18 0 0	20 0 0
12 x 8 "	14 8 0	16 16 0	19 4 0	21 12 0	24 0 0
12 x 10 "	18 0 0	21 0 0	24 0 0	27 0 0	30 0 0

Five per Cent Discount.

Carriage Paid.

Samples submitted on application.

J. RANDS & JEKELL

Dept. J.

IPSWICH

MANUFACTURERS TO H.M. THE KING

BEEF !!

Cost of production
reduced **75 %**

by the Creosoted Stave

NORFOLK SILO.



Particulars and Prices of—

JEWSON & SONS, L^{TD}

Head Office—NORWICH.

CONTENTS.

NOTES FOR THE MONTH—

<i>Agricultural Research—Ministry's Pavilion at the Royal Agricultural Show</i>	301
<i>Machinery and Implements for Food Production—The Mountain Pony: Its Value to Agriculture—Decontrol of Meat and Live Stock</i>	305
<i>Potato Demonstration Plots, 1920—Handbook of British Breeds of Live Stock—Production of Licences for Stallions—Home-Handicraft Exhibits—Baling Hay on the Field</i>	311
<i>Protection of the Lapwing—"Udder Stocking"—Rat Destruction: The Need for concentrated Effort—Foot-and-Mouth Disease in Norfolk</i>	315
SPEECH BY THE MINISTER OF AGRICULTURE AT THE BOTHAMSTED EXPERIMENTAL STATION	320
MORE WHEAT. <i>Sir Daniel Hall, K.C.B., F.R.S.</i>	332
PIG FEEDING AND THE COST OF PORK PRODUCTION. <i>Arthur G. Ruston, D.Sc.</i>	340
POULTRY KEEPING IN FRUIT PLANTATIONS. <i>G. H. Garrad, N.D.A.</i> ...	350
TOMATO CULTURE. <i>J. Stoddart</i>	360
FORAGE CROPS OF DENMARK. <i>W. H. Parker, M.A.</i>	364
THE TEMPORARY LEY AND THE IMPROVEMENT OF GRASS LAND ...	369
CHICKENS AND RABBITS: PROFESSOR PUNNETT'S EXPERIMENTS ...	373
INSECT AND FUNGUS PESTS IN JULY AND AUGUST	375
THE INJURIOUS APPLE CAPSID. <i>Kenneth M. Smith</i>	379
THE GREAT EASTERN RAILWAY DEMONSTRATION TRAIN	382
REDEMPTION OF TITHE RENTCHARGE: THE TITHE ACT, 1918—INCOME TAX LIABILITY OF LANDOWNER AND TITHEOWNER	386
AGRICULTURE ABROAD—	
<i>Horticulture and International Friendship: The British Exhibit at Antwerp—Railway Companies and Agricultural Production in France—Cattle Breeders' Association in South Africa—Live Stock for Devastated Areas in France—Mineral Matter and Milk</i>	389
NOTICES OF BOOKS	393
QUESTIONS IN PARLIAMENT	394
Prices of Sulphate of Ammonia, 1920-21	399
Weather Forecasts for Farmers	400
Regulations for Importation of Hay and Straw	400
Appointment of Controller of Horticulture	401
Fruit Crop Prospects on 1st July	401
Alteration in the Date of Publication of this Journal	401
Additions to the Library	402
Selected Contents of Periodicals	404

Any of the Articles in this Journal may be reproduced in any registered newspaper or public periodical without special permission, provided that the source is acknowledged in each case.

The Ministry does not accept responsibility for the views expressed and the statements made by contributors, nor for any statements made in the advertisement columns of this Journal.

BY ROYAL WARRANT.



FISONS' (IPSWICH) **FERTILIZERS.**

"The best in the world."

FOR ALL CROPS.

**BASIC SLAG.
BONE MEALS.
FISH GUANO.**

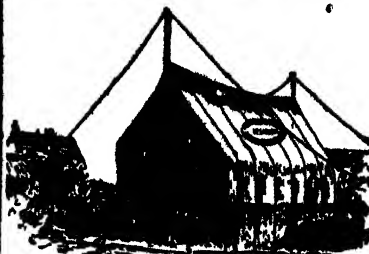
Prompt Delivery.

Full particulars and prices on application.

Joseph Fison & Co., Ltd,
IPSWICH.

**"CERES" RICKCLOTHS AND
STACKSHEETS**

"The Most Satisfactory in the Market."



Rot Proof.

Quality :	J	K	L	H	M
	S	S	S	S	S
	d.	d.	d.	d.	d.
8 x 6 yds	7	4	0	8	0
8 x 8	0	12	0	11	4
10 x 8	0	14	0	10	0
12 x 8	0	16	0	10	0
12 x 10	0	18	0	10	0

Five per Cent. Discount. Carriage Paid.
Best Quality and Workmanship Throughout.

Samples submitted on application to :

J. RANDS & JEKELL
Dept. J. IPSWICH
MANUFACTURERS TO H.M. THE KING.

BEEF !!

Cost of production
reduced **75 %**

by the Creosoted Stave

NORFOLK SILO.



Particulars and Prices of—

JEWSON & SONS, LTD.

Head Office—IPSWICH.

CONTENTS.

NOTES FOR THE MONTH—

<i>Early Sowing of Winter Wheat—Fruit Cultivation in a Gravel Pit— A Woman Adviser to the Ministry—Instruction in Horticulture— Market Gardening and Poultry Keeping—Supply of Fruit Trees for Small Holdings</i>	405
<i>Fish Meal as Food for Live Stock—Planting of Early Potatoes in Infected Areas—Nitrogen from the Air—The Small Holder's Horse—Prosecution for Travelling an Unlicensed Stallion</i>	414
<i>Foot-and-Mouth Disease—The Transport of Food Produce by Aeroplane— Rat Catching in Devonshire—Agricultural Wages Board</i>	419
THE 1921 WHEAT CROP BRITAIN MUST GROW MORE. <i>Sir Thomas Middleton, K.B.E., C.B.</i>	424
THE PROGRESS OF AGRICULTURAL CO OPERATION IN ENGLAND AND WALES SINCE THE ARMISTICE <i>R H. Carr</i>	428
THE WORK OF AGRICULTURAL EXECUTIVE COMMITTEES SINCE THE ARMISTICE	437
FARMYARD MANURE ITS MAKING AND USE <i>E J. Russell, D.Sc.</i>	444
THE DECLINE IN SHEEP BREEDING <i>Sir Henry Row, K.C.B.</i>	450
OPEN AIR PIG-KEEPING	456
ECONOMIC POSITION OF THE POULTRY INDUSTRY <i>Eduard Brown, F.L.S.</i>	458
UTILITY RABBIT KEEPING AT PUBLIC INSTITUTIONS	463
BUILDINGS FOR SMALL HOLDERS EXPERIMENTS IN ADAPTATION. <i>Captain S Douglas Meadows</i>	468
THE SCORCHING OF FOLIAGE BY SEA WINDS <i>L A Boodle</i>	479
PESTS APPEARING DURING AUGUST	487
FREEDING STUFFS IN AUGUST <i>Professor T B Wood, C.B.E., M.A.</i>	490
NOTICES OF BOOKS	493
QUESTIONS IN PARLIAMENT	496
Ormakirk Potato Trials	497
Rabies	497
Leaflets issued by the Ministry	497
Weather Forecasts for Farmers	498
Removal of Prohibition on the Export of Live Stock	498
Re-exportation of Horses from France	498
Export of Oil Cake from France	498
Restricted Importation of Lucerne Seed	499
Additions to the Library	499
Selected Contents of Periodicals	500

Any of the Articles in this Journal may be reproduced in any registered newspaper or public periodical without special permission, provided that the source is acknowledged in each case.

The Ministry does not accept responsibility for the views expressed and the statements made by contributors, nor for any statements made in the advertisement columns of this Journal.

BY ROYAL



WARRANT.

FISON'S'

(IPSWICH)

FERTILIZERS.

"The best in the world."

FOR ALL CROPS.

BASIC SLAG.

BONE MEALS.

FISH GUANO.

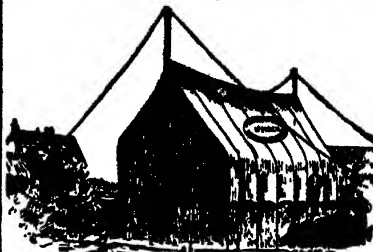
Prompt Delivery.

Full particulars and prices on application.

Joseph Fison & Co. Ltd.,
IPSWICH.

"CERES" STACK SHEETS

Quality, Superior Workmanship, the reliable protection they afford, explains why the "Ceres" brand are described by users as "The Most Satisfactory in the Market."



Rot Proof.

Quality:	J	K	L	H	M
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
8x6yds.	7 40 8	80 9 12	0 10 16	0 13 00	
8x8 "	9 12	0 11 40	12 16	0 14 80	16 00
10x8 "	12 00	14 00	16 00	18 00	20 00
12x8 "	14 80	16 16	0 19 40	21 12	0 24 00
12x10 "	18 00	21 00	24 00	27 00	30 00

Five per Cent. Discount. Carriage Paid.
Samples submitted on application to:

J. RANDS & JEKELL
Dept. J. IPSWICH.
Manufacturers to H.M. the King.

BEEF!!

Cost of production

reduced **75 %**

by the Creosoted Stave

NORFOLK
SILO.



Particulars and Prices of—

JEWSON & SONS, LTD.

Head Office—NORWICH.

CONTENTS.

NOTES FOR THE MONTH—	PAGE
<i>Continuous Wheat Growing—Sowing of Wheat—Milking Machines— Rural Education in Wales—Jam making when Sugar is Scarce ...</i>	501
<i>Substitutes for Hay—Improvement in Poultry Keeping—Poultry Keeping in an Elementary School in Cornwall—Pink Discoloration of Cheese ...</i>	514
<i>Tobacco Growing in England—Potash Supplies—Milk Recording Societies An Interesting Competition—Agricultural Wages Board—Harvest Wages—Foot-and-Mouth Disease</i>	522
THE MODERN COTTAGE EXPERIMENTS IN PIÑÉ AT AMESBURY <i>Clough Williams Ellis</i>	529
GRASS AND CLOVER SEED GROWING IN GREAT BRITAIN <i>S P Merrett, B Sc (Agric) Lond, N D A</i>	535
HOW TO PROTECT WHEAT SOME NOTES ON FUNGUS PESTS <i>A D Cotton</i>	548
THE NATION'S FRUIT AND VEGETABLES PROBLEMS OF PRESERVATION. <i>S L Bensusan</i>	553
THE HARVESTING OF MANCOWS <i>Wilfred S Mansfield and Arthur Amos, M A</i>	559
HAND LOOM WEAVING <i>Professor A F Barker, M Sc</i>	561
GROWING LATE FLOWERING RED CLOVER OR SINGLE CUT COW GRASS FOR SEED	568
DOMESTIC FRUIT BOTTLING WITH OR WITHOUT SUGAR	566
GOOSEBERRY GROWING	572
FEEDING STUFFS IN SEPTEMBER <i>Professor T B Wood, C B E, M A</i>	580
INSECT AND FUNGUS PESTS IN SEPTEMBER	583
AGRICULTURAL RETIERS, 1920 ...	587
NOTICES OF BOOKS	590
QUESTIONS IN PARLIAMENT	591
Ecclesiastical Tithe Rentcharge (Rates) Act, 1920	592
Rabies	593
Experimental Farm to Improve the Cultivation of Maize	593
International Dairy Exhibition at Buenos Aires ...	593
Wet Weather and Animal Disease	594
Leaflets issued by the Ministry	594-
Additions to the Library ...	595

Any of the Articles in this Journal may be reproduced in any registered newspaper or public periodical without special permission, provided that the source is acknowledged in each case.

The Ministry does not accept responsibility for the views expressed and the statements made by contributors, nor for any statements made in the advertisement columns of this Journal.

By ROYAL



WARRANT

FISON'S'

(IPSWICH)

FERTILIZERS.

"The best in the world."

FOR ALL CROPS.

BASIC SLAG.

BONE MEALS.

FISH GUANO.

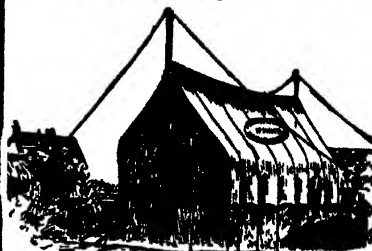
Prompt Delivery.

Full particulars and prices on application.

Joseph Fison & Co. Ltd.,
IPSWICH.

"CERES" STACK SHEETS

Quality, Superior Workmanship, the reliable protection they afford, explains why the "Ceres" brand are described by users as "The Most Satisfactory in the Market."



Hot Proof

Quality	J	K	L	H	M
	£ s d	£ s d	£ s d	£ s d	£ s d
8x6yds	7 40 8	80 9 120	10 160	12 00	12 00
8x8 "	9 120	11 40 12	160 14	80 1800	
10x8 "	12 00	14 00 16	00 18	00 2000	
12x8 "	14 80	16 160	19 40 21	120 2400	
12x10 "	18 00	21 00 24	00 27	00 8000	

Five per Cent. Discount Carriage Paid
Samples submitted on application to

J. RANDS & JEKELL
Dept. J. IPSWICH.
Manufacturers to H M the King

YOU CANNOT FEED CATTLE PROFITABLY
without SILAGE.

A WOOD SILO
makes the best Silage.

NEXT YEAR
the demand for Silos will
much exceed the supply.
ORDER your Silo now
to prevent disappointment.



Particulars and Prices of—

JEWSON & SONS, LTD.

TIMBER IMPORTERS AND CREOSOTERS,

Head Office—NORWICH.

CONTENTS.

NOTES FOR THE MONTH—	PAGE
<i>Wheat Cultivation—Climate Soils and Varieties—Winter Oats—Schools for Women's Institute Organisers—Renovation of neglected Orchards</i>	597
<i>The Seeds Act, 1920—Agricultural Prices—The Improvement of Moorland Pasture—Winter Feeding of Poultry—Winter Egg Production—Poultry on Stubbles</i>	604
<i>Agriculture and the new Railway Routes—The Winter Storage of Potatoes and other Vegetables—The Development of Rural Industries—Jelly from Under Apples—Destruction of Charlock—Experiments in Northamptonshire Foot and Mouth Disease</i>	617
THE HISTORY OF A GRAIN OF WHEAT FROM THE SEED BED TO THE BREAKFAST TABLE <i>Sir A. D. Hall, K.C.B., F.R.S.</i>	624
PLANT BREEDING WORK AT ABERYSTWYTH <i>Professor R. G. Stapledon, M.A.</i>	650
THE BRITISH DAIRY FARMERS' ASSOCIATION <i>F. J. Lloyd, F.C.S., F.I.C.</i>	640
BREEDING DAIRY CATTLE FOR MILK PRODUCTION <i>J. Mackintosh, O.B.E.</i>	647
THE LIFE HISTORY OF THE COMMON MOLE <i>Lionel E. Adams, B.A.</i>	659
ACCESSORY FOOD FACTORS OF VITAMINS	666
'DAMPING OFF' OF TOMATO SEEDLINGS <i>W. F. Bailey</i>	670
PENENNIAL RYEGRASS AND WILD WHITE CLOVER	674
COMMERCIAL MUSHROOM CULTIVATION	678
FEEDING STUFFS IN OCTOBER <i>Professor T. B. Wood, C.B.E., M.A., F.R.S.</i>	681
MANURES IN OCTOBER <i>E. J. Russell, D.Sc., F.R.S.</i>	683
NOTICES OF BOOKS	686
Sulphate of Ammonia—Increased Prices	688
Basic Slag—Increased Prices	688
Sale of Cereal Seed	688
Examination of Live Bees suspected of Disease	689
Precautions against Cattle Plague	689
Leaflets issued by the Ministry	690
Jam making with Brown Sugar	690
Exportation of Seed Potatoes to Holland	690
Rabies	691
Additions to the Library	692

Any of the Articles in this Journal may be reproduced in any registered newspaper or public periodical without special permission, provided that the source is acknowledged in each case.

The Ministry does not accept responsibility for the views expressed and the statements made by contributors, nor for any statements made in the advertisement columns of this Journal.

By ROYAL



WARRANT.

FISON'S
(IPSWICH)
FERTILIZERS.

"The best in the world."

FOR ALL CROPS.

BASIC SLAG.

BONE MEALS.

FISH GUANO.

Prompt Delivery.

Full particulars and prices on application.

Joseph Fison & Co. Ltd.,
IPSWICH.

ESSENTIAL TO ECONOMY

To prevent loss, reliable covers are essential for protecting produce in transport, and costly machinery.

"CERES" COVERS

are waterproof in addition to being rotproof, while their great durability makes them economical.

MADE FOR

**WAGONS, ENGINES, TRACTORS AND
ALL ESTATE AND FARM PURPOSES.**

Prices from 5 - per square yard,

Subject to 5 per cent. discount.

Write for samples, the quality will convince you.

J. RANDS & JECKELL

DEPT. J.

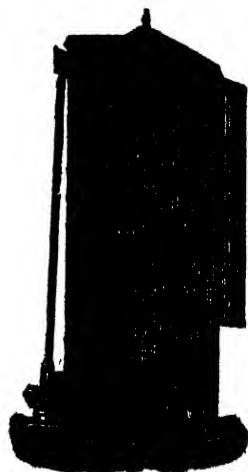
IPSWICH.

Manufacturers to H. M. The King.

YOU CANNOT FEED CATTLE PROFITABLY
without **SILAGE.**

A WOOD SILO
makes the best Silage.

NEXT YEAR
the demand for Silos will
much exceed the supply.
ORDER your Silo now
to prevent disappointment.



Particulars and Prices of—

JEWSON & SONS, LTD.
TIMBER IMPORTERS AND CREOSOTERS.

Head Office—**NORWICH.**

CONTENTS.

NOTES FOR THE MONTH—	PAGE
<i>Prices for British Wheat—Trials of New Varieties of Winter Wheat in 1919—Sowing Crops in General Farming</i> . . .	693
<i>The Ormskirk Potato Trials Report for the Year 1919—Planting of Susceptible Varieties of Potatoes in Wart Disease Infected Areas—Corky Scab of Potatoes</i> ..	697
<i>Restocking of Bees Scheme—Importation of Canadian Store Cattle—The Humane Slaughter of Animals—The Export of Deceitful Horses</i> ...	701
<i>The Keeping of Small Live Stock by Allotment Holders and Householders—Agricultural Wages Board—National Rat Week—Importance of Sowing Clean Cereal Seed</i>	711
NOTES ON THE LINCOLN TRACTOR TRIALS, 1920 <i>Thompson Close, B. J. Owen, B.Sc., and H. G. Richardson, M.A., B.Sc.</i>	714
THE USE OF SOILING CROPS IN GENERAL FARMING. <i>J. C. Brown, P.A.S.I.</i>	725
COTTAGE ADAPTATION AND RESTORATION. <i>Marshall Ayrton, F.R.I.B.A.</i>	730
THE DISTRIBUTION OF WART DISEASE. <i>H. V. Taylor, M.B.E., A.R.C.Sc., B.Sc.</i>	733
PLANT BREEDING WORK AT ABERYSTWYTH <i>Professor R. G. Stapledon, M.A.</i>	739
LICENSING OF STALLIONS UNDER THE HORSE BREEDING ACT, 1918 : SEASON 1920	749
EDUCATION IN POULTRY KEEPING <i>Percy A. Francis</i>	753
PROFITABLE PEARS FOR MARKET	760
LAND DRAINAGE	764
THE DORSET ARTS AND CRAFTS ASSOCIATION <i>Miss M. B. Mansel</i> ...	769
INSECT AND FUNGUS PESTS DURING THE WINTER—THE IMPORTANCE OF PLANT HYGIENE <i>Geo. C. Gough, A.R.C.Sc.</i>	772
FEEDING STUFFS IN NOVEMBER. <i>Professor T. B. Wood C.B.E., M.A., F.R.S.</i>	776
AGRICULTURE ABROAD	
<i>The Cinema as an Aid to Agriculture—the Hoyberg Process of testing the Fat Content of Milk—the Economics of Small Farming</i>	778
Application for Licences under the Horse Breeding Act, 1918	785
Imported Seed Potatoes from Scotland	785
Export of Potatoes to Holland	785
Leaflets issued by the Ministry	786
Foot-and-Mouth Disease ..	786
Rabies	787
Importation of Hops	787
Free Entry for certain Agricultural Machinery into Tunis ..	787
Selected Contents of Periodicals	788

Any of the Articles in this Journal may be reproduced in any registered newspaper or public periodical without special permission, provided that the source is acknowledged in each case.

The Ministry does not accept responsibility for the views expressed and the statements made by contributors, nor for any statements made in the advertisement columns of this Journal.

By ROYAL



WARRANT.

FISON'S'
(IPSWICH)
FERTILIZERS.

"The best in the world."

FOR ALL CROPS.

BASIC SLAG.

BONE MEALS.

FISH GUANO.

Prompt Delivery.

Full particulars and prices on application.

Joseph Fison & Co. Ltd.,
IPSWICH.

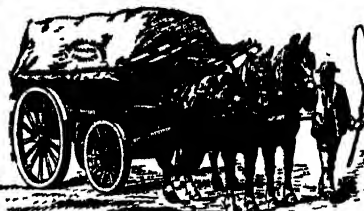
"CERES" COVERS

ROT-PROOF AND WATER-PROOF

For **WAGONS, MACHINES,**
TRACTORS, etc.,

Superior quality of materials and best workmanship make them, as described by users,

"Far Superior to any others."



Prices from 5/- per square yard

Less 5 per cent discount.

Carriage paid on orders of 40/-

Write for samples to—

J. RANDS & JEKELL

DEPT. J.

IPSWICH.

Manufacturers to H. M. The King.

YOU CANNOT FEED CATTLE PROFITABLY
without **SILAGE.**

A **WOOD SILO**
makes the best Silage.

NEXT YEAR
the **DEMAND** for Silos will
much exceed the **SUPPLY.**

ORDER your Silo now
to prevent disappointment.

Particulars and Prices of—

JEWSON & SONS, LTD.

TIMBER IMPORTERS AND CREOSOTERS.

Head Office—NORWICH.



CONTENTS.

NOTES FOR THE MONTH—	PAGE
<i>The Minister's Speech at Leicester—The Formation of County Agricultural Committees—The Reclamation of Waste Land by Agricultural Means—Cumberland and Westmorland as Nurseries for Seed Potatoes—The Purchase of Seeds—The Smithfield Club and its History</i>	789
<i>Village Clubs Association Conference—The Equipment of Small Holdings: Cottage Planning—Diseases in Animals during 1919—Poisoning of Live Stock by Yew—Importation of Potatoes into Ireland</i> ..	800
<i>New Railway Regulations for Conveyance of Plants and Flowers—Allotments: Compulsory Hiring—London Thoroughbred Stallion Show, 1921</i>	812
SPEECH BY THE MINISTER OF AGRICULTURE AT LEICESTER	816
THE ENCLOSURE OF OPEN-FIELD FARMS. <i>The Right Hon. Lord Ernle, M.V.O.</i>	831
MILK RECORDING IN ENGLAND AND WALES .. .	842
EDUCATION AND RESEARCH IN POULTRY KEEPING .. .	847
DISTRIBUTION OF SITTINGS OF EGGS AND DAY-OLD CHICKS .. .	854
THE NATIONAL FEDERATION OF WOMEN'S INSTITUTES. <i>M. Frida Hartley...</i>	858
THE DISTRIBUTION OF WART DISEASE. <i>H. V. Taylor, M.B.E., A.R.C.Sc., B.Sc.</i> .. .	863
THE ROOK: ITS RELATION TO THE FARMER, FRUIT GROWER AND FORESTER. <i>W. E. Collinge, D.Sc.</i> .. .	868
MANURES IN DECEMBER. <i>E. J. Russell, D.Sc., F.R.S.</i> .. .	876
FEEDING STUFFS IN DECEMBER. <i>E. T. Halnan, M.A.</i> .. .	883
QUESTIONS IN PARLIAMENT .. .	886
Agricultural Returns, 1920: Produce of Crops in England and Wales	888
Egg Prices .. .	890
Ministry's Exhibit of Varieties of Potatoes Immune from Wart Disease ..	890
Leaflets issued by the Ministry .. .	890
Map showing Areas declared Infected with Wart Disease in Scotland	891
Extension of the Rothamsted Laboratories ..	891
Rothamsted Experimental Station .. .	891
Closing of Woburn Fruit Experimental Farm ..	891
The Ormskirk Potato Trials, 1919: Erratum .. .	891
Foot-and-Mouth Disease .. .	892
Rabies .. .	892

Any of the Articles in this Journal may be reproduced in any registered newspaper or public periodical without special permission, provided that the source is acknowledged in each case.

The Ministry does not accept responsibility for the views expressed and the statements made by contributors, nor for any statements made in the advertisement columns of this Journal.

BY ROYAL



WARRANT.

FISONS'
(IPSWICH)
FERTILIZERS.

"The best in the world."

FOR ALL CROPS.

BASIC SLAG.

BONE MEALS.

FISH GUANO.

Prompt Delivery.

Full particulars and prices on application.

Joseph Fison & Co. Ltd.,
IPSWICH.

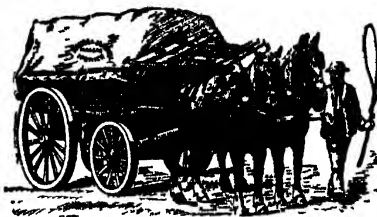
"CERES" COVERS

ROTPROOF AND WATERPROOF

For **WAGONS, MACHINES,**
TRACTORS, etc.,

Superior quality of materials and best workmanship make them, as described by users,

"Far Superior to any others."



Prices from 5/- per square yard

Less 5 per cent discount

Carriage paid on orders of 40/-

Write for samples to—

J. RANDS & JECKELL

DEPT. J

IPSWICH.

Manufacturers to H.M. The King

SILAGE is the Best and Cheapest
Winter Food for Cattle.

If you wish to make

FARMING PAY

grow Silage Crops Instead
of Roots, and

ORDER YOUR SILO NOW.

Particulars and Prices of—

JEWSON & SONS, LTD.

TIMBER IMPORTERS AND CREOSOTERS.

Head Office—NORWICH.



CONTENTS.

NOTES FOR THE MONTH—	PAGE
<i>First Meeting of the Agricultural Council for England—Meeting of the Advisory Agricultural Committee—Correspondence with the National Farmers' Union as to Prices of Home-Grown Wheat—The Price of Home-Grown Wheat</i>	893
THE ENCLOSURE OF OPEN-FIELD FARMS. <i>The Rt. Hon. Lord Ernle, M.V.O.</i>	899
THE AGRICULTURAL COUNCIL FOR ENGLAND: THE MINISTER'S INAUGURAL ADDRESS	912
A MODERN HERTFORDSHIRE FARM: AN EXAMPLE OF UP-TO-DATE METHODS	921
MOORLAND GRAZING: ITS IMPROVEMENT BY HEAVY STOCKING. <i>Capt. Anthony Thompson, M.Sc., A.S.I., and Miss D. Armstrong, B.Sc., N.D.A.</i>	928
THE REVIVAL OF THE SUSSEX TABLE POULTRY INDUSTRY. <i>J. W. Hurst</i>	934
WOMEN'S INSTITUTES AND AGRICULTURAL EDUCATION. <i>Percy G. Dallinger, O.B.E., B.A.</i>	940
A CAMPAIGN FOR INCREASED WHEAT PRODUCTION: IMPROVED VARIETIES AND MANURES	943
THE DISTRIBUTION OF WART DISEASE. <i>H. V. Taylor, M.B.E., A.R.C.Sc., B.Sc.</i>	946
THE INSPECTION OF POTATO CROPS DURING 1920: MEASURES FOR CONTROL OF DISEASE IN POTATO	954
POTATO GROWING	958
MANURES IN JANUARY <i>D.Sc., F.R.S.</i>	960
FEEDING STUFFS IN JANUARY <i>Halnan, M.A., Dip. Agric. (Cantab.)</i>	964
NOTES ON POULTRY KEEPING	967
REPAIR AND MAINTENANCE OF ... MACHINES	973
MOLE DRAINING	977
AGRICULTURE ABROAD:	
<i>Wool and Leather in China—Seed Crops in Rumania—Produce on Large and Small Holdings in Rumania</i>	980
Cost of Production of Winter Milk	983
Agricultural Research Scholarships	984
Tithe Redemption	984
Leaflets issued by the Ministry	985
Approximate Areas of Land at Different Altitudes	985
Rabies	986
Foot-and-Mouth Disease	986
Additions to Library	987

Any of the Articles in this Journal may be reprinted in any registered newspaper or public periodical without special permission, provided that the source is acknowledged in each case.

The Ministry does not accept responsibility for the contents of the advertisements, nor for any statements made in the advertisements.

By ROYAL



WARRANT

FISON'S'

(IPSWICH)

FERTILIZERS.

"The best in the world."

FOR ALL CROPS.

BASIC SLAG.

BONE MEALS.

FISH GUANO.

Prompt Delivery.

Full particulars and prices on application.

Joseph Fison & Co. Ltd.,
IPSWICH.

BETTER BREEDING RESULTS

can be obtained by using

**SHEEP AND LAMB
SHELTERING CLOTHS**



**SPLENDID OPEN-AIR SHELTERS
INEXPENSIVE ——— LASTING**

Made in two varieties, viz —

"DUPLA" Windward & Overhead Shelter
(as illustrated)

"SIMPLA" Windward Protection only.

Write for Samples and Prices to

J. RANDS & JECKELL,
Dept. J ——— IPSWICH.

Manufacturers to H.M. The King

**SILAGE is the Best and Cheapest
Winter Food for Cattle.**

If you wish to make

FARMING PAY

*grow Silage Crops Instead
of Roots, and*

ORDER YOUR SILO NOW.

Particulars and Prices of—

JEWSON & SONS, LTD.

THE IMPORTERS AND CONTRACTORS

Office—NOTES



CONTENTS.

NOTES FOR THE MONTH	PAGE
<i>The Ministry's New Offices—Foot-and-Mouth Disease in the Midlands— Outbreaks of Rabies: The Duty of the Public—Journal Supplement on Official Seed Testing during 1919-20—Acreage and Live Stock Returns</i>	989
THE AGRICULTURE ACT, 1920	994
THE EMBARGO ON THE IMPORTATION OF CANADIAN STORE CATTLE: DEPUTATION TO THE MINISTER	999
FOOT-AND-MOUTH DISEASE: THE QUESTION OF INVASION	1004
THE MODERN COTTAGE OF CHALK AND CEMENT. <i>John F. Wilkes</i>	1010
PREVENTION OF "BUNT" IN WHEAT. <i>E. S. Salmon and H. Wormald</i>	1013
RECENT RESEARCH IN EGG PRODUCTION. <i>J. Hammond, M.A.</i>	1022
A SHELL FACTORY: FOR POULTRY	1033
PROFITABLE EGG PRODUCTION: HIGH PRODUCTIVITY ESSENTIAL	1035
SYNTHETIC NITROGENOUS FERTILISERS. <i>E. J. Russell, D.Sc., F.R.S.</i>	1037
PIT, TRENCH, AND OTHER IMPROVED SILOS. <i>A. W. Oldershaw, M.B.E., B.Sc.</i>	1046
RAT DESTRUCTION BY GOVERNMENT AID. <i>E. C. Read</i>	1052
IMPROVEMENT OF GRASS LAND: THE IMPORTANCE OF EXPERIMENTS. <i>T. J. Jenkin, M.Sc.</i>	1056
AGRICULTURE AS AN OCCUPATION FOR WOMEN. <i>Gertrude Watkin</i>	1060
MANURES FOR FEBRUARY. <i>E. J. Russell, D.Sc., F.R.S.</i>	1064
FEEDING STUFFS FOR JANUARY. <i>E. T. Halnan, M.A., Dip. Agric. (Cantab.)</i>	1069
AGRICULTURE ABROAD:	
<i>Live Stock Exhibition in Argentina—Exports of Produce from Denmark— Wart Disease of Potatoes on the Continent</i>	1072
Silver Leaf Order of 1919	1077
Produce and Yield of Potato and Root Crops, 1920	1077
Corky Scab of Potatoes: Recent Investigation	1078
Foot-and-Mouth Disease	1080
Rabies	1081
Tithe Rentcharge: New Basis for Redemption	1081
English and Welsh Seed Potatoes: Importation into Scotland	1082
The Eggs (Distribution or Sale) Order, 1920	1082
Agricultural Training for Ex-Officers	1082
Notices of Books	1088
Leaflets issued by the Ministry	1084

Any of the Articles in this Journal may be reproduced in any registered newspaper or public periodical without special permission, provided that the source is acknowledged in each case.

The Ministry does not accept responsibility for the views expressed and the statements made by contributors, nor for any statements made in the advertisement columns of this Journal.



BY APPOINTMENT.

FISONS'

IPSWICH

FERTILIZERS

"The Best in the World."

The following among other awards
have been obtained by their use—

Championship of the World for Barley
Six Times—Brewers' Exhibition, London.

First Prize for Barley, Birmingham
Fat Stock Show, 1920.

Gloucester County Cup, 1920.

Twenty-Guinea Cup for General Crop
of Roots.

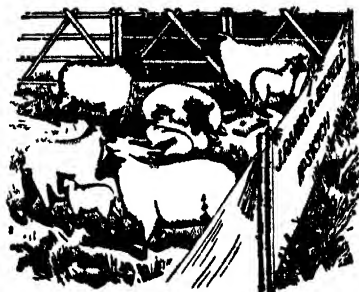
Write for Illustrated Pamphlet and Prices.

JOSEPH FISON & CO., LD.,
IPSWICH.

BETTER BREEDING RESULTS

can be obtained by using

SHEEP AND LAMB SHELTERING CLOTHS



SPLENDID OPEN-AIR SHELTERS INEXPENSIVE ——— LASTING

Made in two varieties, viz.:-

"SIMPLA" Windward Protection only
(as illustrated).

"DUPLA" Windward & Overhead Shelter.

Write for Samples and Prices to:-

J. RANDS & JECKELL,
Dept. J ——— IPSWICH.

Manufacturers to H.M. The King.

SILAGE is the Best and Cheapest Winter Food for Cattle.

If you wish to
SAVE LABOUR
grow Silage Crops instead
of Roots, and
ORDER YOUR SILO NOW.



Particulars and Prices of—

JEWSON & SONS, LTD.

TIMBER IMPORTERS AND CROCKERS.

Head Office—NORWICH.

CONTENTS.

NOTES FOR THE MONTH	PAGE
<i>New Minister of Agriculture and Fisheries—Store Cattle: The Case against Imports—Foot-and-Mouth Disease: The Ministry's Policy—The Bee Disease Bill—The Tenth Report of the Development Commissioners—England's First Calf Club...</i>	1085
HOME-GROWN WHEAT PRICES	1091
THE NEW FARMING LANDOWNER. <i>The Earl of Selborne, K.G., G.C.M.G.</i>	1099
THE IMPROVEMENT OF PEATY SOILS. PART I—THE TRUE PEATS. <i>E. J. Russell, D.Sc., F.R.S.</i>	1104
THE STARLING: IS IT INJURIOUS TO AGRICULTURE? <i>Walter E. Collinge, D.Sc., F.L.S.</i>	1114
REVERSION OF BLACKCURRANTS: A METHOD OF IDENTIFICATION. <i>A. H. Lees, M.A.</i>	1122
THE BREEDING AND REARING OF TURKEYS. <i>C. A. Flatt.</i>	1128
WOMEN IN HORTICULTURE: FUTURE PROSPECTS. <i>Kate Barratt, D.Sc.</i> ...	1137
WITHER TIP AND BROWN ROT OF PLUMS	1142
POTATO DISEASE (BLIGHT) IN 1920	1146
DEPUTATION OF TRADES UNION CONGRESS	1148
NOTES ON MANURES FOR MARCH. <i>E. J. Russell, D.Sc., F.R.S.</i>	1152
NOTES ON FEEDING STUFFS FOR MARCH. <i>E. T. Hainan, M.A., Dip. Agric. (Cantab.)</i>	1154
NOTES ON POULTRY KEEPING: <i>Prices of Eggs and Feeding Stuffs—Chicken Rearing</i>	1157
AGRICULTURE ABROAD: <i>Keeping Farm Accounts—Firing of Haystacks</i>	1161
Co-operative Farming on Smallholdings	1165
Training at Telscombe	1166
Rogueing of Peas	1167
Distribution of Elvers	1168
Regulations as to Dipping of Sheep	1170
Onion Smut Order	1170
Dry Rot of Potatoes	1171
Foot-and-Mouth Disease	1172
Babies	1172
Trench System of Ensilage	1173
The Examination of Diseased Bees	1174
Reduction in Price of Sulphate of Ammonia	1174
Notice to Stallion Owners: Licences under the Horse Breeding Act, 1918 ...	1174
A Map of Wart Disease Infected Areas	1174
Horticultural Inspection for Export: New Scale of Charges	1175
Leaflets issued by the Ministry	1175
Notices of Books	1176
Additions to the Library	1178
Selected Contents of Periodicals	1180

"Any of the Articles in this Journal may be reproduced in any registered newspaper or public periodical without special permission, provided that the source is acknowledged in such case.

The Ministry does not accept responsibility for the views expressed and the statements made by contributors, nor for any statements made in the advertisement columns of this Journal.



BY APPOINTMENT.

FISONS'

IPSWICH

FERTILIZERS

"The Best in the World."

The following among other awards have been obtained by their use:—

Championship of the World for Barley
Six Times—Brewers' Exhibition, London.

First Prize for Barley, Birmingham
Fat Stock Show, 1920.

Gloucester County Cup, 1920.

Twenty-Guinea Cup for General Crop
of Roots.

Write for Illustrated Pamphlet and Prices.

JOSEPH FISON & CO., LD.,
IPSWICH.

SAVE YOUR LAMBS.

Provide adequate protection, which is so
essential for your flock at lambing time,

BY USING

SHEEP AND LAMB SHELTERING CLOTHS



Made in two varieties, viz.:—

"SIMPLA" Windward Protection only
(as illustrated).

"DUPLA" Windward & Overhead Shelter.

Easily Erected. Inexpensive.
Durable.

Write for Samples and full particulars to.

J. RANDS & JEKELL,
Dept. J. IPSWICH.
Manufacturers to H.M. The King

SILAGE is the Best and Cheapest Winter Food for Cattle.

If you wish to be

Independent of Weather

*grow Silage Crops instead
of Roots, and*

ORDER YOUR SILO NOW.

Particulars and Prices of—

JEWSON & SONS, LTD.

TIMBER IMPORTERS AND CROSTERS.

Head Office—NORWICH.



THE JOURNAL

OF THE

MINISTRY OF AGRICULTURE

Vol. XXVII. No. 1.

APRIL, 1920.

NOTES.

THE Report of the Departmental Committee on Agricultural Machinery* may be considered to mark a new epoch in British farming. It is a recognition of the fact that old-fashioned methods will no longer suffice, and that if our food production is to be brought to the utmost point of efficiency, the farmer must employ the best mechanical power as an auxiliary to the skill which he has acquired by centuries of tradition. Not only must he have at his command machinery of the highest excellence, but he must know how to make the best use of it. By this means alone will it be possible to reduce the costs of production upon which the price of the nation's food depends.

The Committee, after a wide survey of the field and the examination of many witnesses, find the present position unsatisfactory. They make a series of weighty recommendations, which, if faithfully carried out, should prove of marked benefit to British farming. With regard to machinery, the Committee point out that hitherto manufacturers seem to have paid far too little attention to the principles of pure science underlying machine construction. The Report admits that a period of empiricism, during which the method is one of trial and error, is inevitable to the development of any science, but there comes a point beyond which such a rule-of-thumb will no longer serve the cause of progress. Hence the need for properly organised and systematic research in all branches of agricultural engineering. It is a fact that many of our industries, including even the small industry of confectionery, have set up their own Research Associations, although, singularly enough, nothing in this direction seems to have been considered by agricultural engineering, with the single exception, perhaps, of the tractor branch of the industry. It is assumed by the Report that a Research Institute on

* The Report of this Committee is noticed at p. 91.

Agricultural Machinery will shortly be established. The Committee expect that that body will be aided by any Industrial Research Association that may be formed in connection therewith. They advocate further the formation in this country of a permanent organisation to test agricultural machinery and implements, and recommend that such tests should be organised and carried out by the Ministry of Agriculture, and that both farmers and manufacturers should have an important share in the arrangements. A Central Advisory Committee is suggested, on which agriculture, agricultural engineering and a small official element should be represented. In this connection it is interesting to note that the witnesses before the Committee were unanimous in suggesting the initiation of such tests.

Excellent machinery, however, is of little use, unless farmers can readily acquire knowledge of it. At present they have to depend upon neighbours' opinions, interested agents' statements, Press notices, and awards of Agricultural Societies. The Committee recommend, therefore, that the Ministry should establish an Information Bureau which would collect descriptions and record performances of agricultural machinery and implements. A definite educational scheme is also proposed. Under this, instruction in mechanics, theoretical and applied, would be given in rural districts to youths under 14, while more specialised lectures would be available to farmers and kindred workers. College and Farm Institutes are also advised to equip themselves for practical demonstrations in agricultural machinery. A further part of the education scheme is the provision of expert advice, machinery demonstrations, and lectures illustrated by the cinematograph and lantern slides. Finally the Report urges that the Ministry should encourage this movement in every county or area, and presses home the need for co-ordination between all persons interested.

* * * * *

In evidence given before the Departmental Committee of the Ministry* appointed to advise on the question of the development of agricultural machinery, successive witnesses referred to the change which the conditions produced by the War have brought about in the attitude of farmers in this country towards the use of machinery. While the introduction of the motor tractor was clearly foremost in

**Development of
Agricultural
Machinery.**

* See above.

the mind of most of the witnesses, it is evident that the last five years have introduced fresh elements into the whole problem. The shortage of labour caused by the withdrawal of man-power to the Army forced the farmer to place greater reliance on machinery, while at the same time the economic changes of the last few years have brought about a large advance in the wages of farm workers. We have to recognise also that the present comparative prosperity of the farmer has enabled him to purchase machinery more freely than he was able to do formerly. The factors which were in operation before the War, and which placed this country in a position of relative inferiority, so far as the use of machinery was concerned, to some others both in Europe and America, have not, however, been entirely eliminated.

Reasons for Unreadiness to purchase in the Past.—The unreadiness of many farmers in the past to adopt labour-aiding devices cannot, in the opinion of the Committee, be traced to any great extent to their unfavourable financial position, but is largely attributable to the cheapness of labour and to the influence of a tradition and social environment inimical to change, which was shared by all classes of the agricultural community. It is a commonplace of industrial history that low wages tend to stereotype methods of production, and agriculture has not been exempt from this tendency. Even so late as the beginning of the War, the self-binder had not been adopted in some arable districts of the country, and in not a few cases the tractor was regarded with unreasonable hostility and prejudice which even now have not entirely disappeared.

Incentives to Use of Machinery.—At the moment agriculture is passing through a period of transition. The farmer is, on the whole, in a better position to purchase machinery than he has been for many years, his outlook has been modified by his experiences during the War, and he has the stimulus of a heavy labour bill which, if he is to maintain his area under tillage crops, he can meet but in two ways—by obtaining a more efficient service from each worker, or by adding his labour costs to the price of his products. Of these alternatives, the Committee do not hesitate to suggest, only the former can be considered.

Influence of Machinery on Cost of Production and Methods of Farming.—Up to a certain limit the costs of production can be diminished by increased use of fertilisers or by improved methods of cultivation, but a large proportion of the land

in this country is already well and highly farmed, and although the Committee do not doubt that further efforts may be made in this direction, they consider that greater possibilities lie in increasing the efficiency of the worker by the extended and instructed use of labour-aiding machinery. Apart from the value of machinery as a means of reducing the cost of farming operations they emphasise the possibility of securing, by the application of improved machinery, an actual increase in production. The Committee received conclusive evidence of the great increase in power which machinery gave a farmer to carry on work whenever he found it most advantageous, or, in other words, when he would get the maximum production for the minimum of expense. To take the tractor as an example: this machine gives better opportunities for bastard fallows, early sowings and rapid harvestings, than horses do. In the past the farmer has often been compelled to sow at a time when he knew conditions were not really favourable; the tractor enables him to take full advantage of brief spells of favourable weather, to get his ploughing done in the late summer and early autumn, and to sow whenever he desires. On the farm attached to the Rothamsted Experimental Station it has been possible by using a tractor to reduce the amount of fallow cropping, to reduce the necessity for dead fallows, and to get winter oats in early and do away with the necessity for spring oats, which on the heavy land at the farm were almost invariably a bad crop. Further, wheat can be got in earlier, needing less seed for sowing and giving a better plant; and instead of being compelled sometimes to have rather too large an area under roots, it has been possible to have as much winter corn as was considered desirable. The introduction of machinery, moreover, makes possible certain operations, such as land drainage, which would otherwise be almost impracticable in many districts on account of the high price of manual labour.

• • • • • •

THE extensive breaking up of grass land during the War raised keen speculation as to the results of cropping and yield on the land so broken. To this question the Ministry has given close attention. For the second year in succession cropping reports on the land originally broken up for the cereal year 1917-18 have been called for, and forty-nine reports for forty-two geographical counties have been received. Unfortunately they omit three such large areas as Cornwall,

**The Productiveness
of the "New"
Arable.**

Lancashire and the West Riding of Yorkshire, all of which were fully reported for 1918.

The 1919 yield of all crops was the lowest within recent years. The returns from the new arable land reflect this and are uniformly below those of 1918, but not to the same degree as those obtained from the "old" arable.

Oats gave the best crop, wheat next, and barley third in order. The wheat yield for 1919 is practically equal to that of 1918. Oats grown on the new land averaged a bushel per acre higher than those from the rest of the arable. Barley declined only 0.8 of a bushel from the very low yield of 28.8 bushels in 1918, and was, all things considered, satisfactory.

Other cereals declined considerably. Root crops, on the other hand, while below the previous year, gave better results on the "new" arable than on the "old." Peas approached the average.

As the area under cereals had diminished and had been redistributed, the "new" arable had not by 1919 assumed its place in the normal rotation, an undue proportion having been retained under corn. For other crops the data are as yet insufficient to give a trustworthy indication, but the areas under beans, potatoes and roots seem to have slightly increased, while the average under mixed corn and peas has diminished.

* * * * *

WITH the object of demonstrating how poor heath land can be improved by good husbandry, the Ministry last year purchased an estate of over 1,500 acres at Methwold in Norfolk, which will be known as the National Demonstration Farm of the Ministry. On this area, 1,043 acres are under arable cultivation, 43 acres are under grass, and 441 acres are waste heath. The estate is a stretch of typical Norfolk heath land in a poor state of cultivation, and in the past has been largely devoted to game. It includes 200 acres of land previously under bracken, which have been reclaimed under the auspices of the Development Commissioners.

In farming this large area, the Ministry intends to continue the work of the reclamation of the bracken land and to make full use of labour-saving implements and machinery. The principal part of the scheme will be the improvement of the

land by chalking (chalk occurs near the surface at convenient points) and by the addition of organic matter. The latter will be supplied by folding sheep and ploughing in green manure. As the soil is notably deficient in potash, liberal dressings of this manure will be applied.

The scheme of demonstration also includes pig breeding and rearing on the open-air system, stock rearing, and poultry keeping. A feature of the cultivation of this land will be the growth of tobacco on a comparatively large scale. During the present season, the area under this crop is not likely to exceed 10 acres, but later this will be raised to 30 acres. Arrangements are being made to provide the plant necessary for the propagating and rehandling of the tobacco crop on an area of 35 to 50 acres. The objects which the Ministry has in view are:—(1) to supplement the experimental work carried out by the British Tobacco Growers' Society, Ltd., during the past six years, which has been aided by the Development Commissioners, and (2) to assist those small holders in the neighbourhood who may wish to grow tobacco on a small scale by providing a central station for the after-treatment of their crops. The character of the soil in the Methwold district is suited to the production of bright tobacco, and the crop *may prove profitable to the local small holders who, while able to grow tobacco, are unwilling or unable to raise the plants or to devote the care necessary to the crop, without advice and supervision.*

The treatment of the estate as a whole will probably elicit valuable information as to the possibilities both of large-scale farming and of small holdings—large-scale farming because the fields are large and well adapted to the use of modern implements and machinery, and small holdings because, if the conditions of the soil can be improved, the light and early character of the land would render it specially suitable for small arable dairy holdings, more or less on the lines of Danish farming.

* * * * *

DURING the War wide powers were given to the Ministry to take over and cultivate land which, it was thought, was not being farmed to the best advantage. These powers were delegated to County Agricultural Executive Committees, and were exercised in practically every county in England and Wales. Possession of badly-farmed land was taken in over 1,000 instances, covering a

**Cultivation of Land
by
County Executive
Committees.**

total area of about 64,000 acres. In a large number of cases the land has been let to suitable tenants for a period of two years after the termination of war, with a possible extension for a further period of three years. A great part of the land, however, has been kept in hand and farmed under the supervision of the Executive Committees. In some counties, such as Essex, Kent, Leicestershire and East and West Suffolk, practically all the land taken over has been dealt with in this way. The total area farmed either directly or indirectly by the Agricultural Executive Committees was at one time nearly 40,000 acres.

During the past year numerous farms have been inspected, and reports afford striking evidence of the beneficial results of action taken by County Committees. In Essex, for instance, land which was acquired as a building estate about twenty years ago and sold in small plots, was taken over by the Committee on behalf of the Ministry in the summer of 1917. It was overgrown with scrub, and barely sufficed to maintain a few cattle and sheep in store condition. Hedges grew wild, ditches filled up, and drains became blocked. Cultivation began in the early autumn, and by May, 1918, out of a total of 166 acres, 82 acres were already under crop, 33 acres were being bare-fallowed in preparation for wheat, and 49 acres were still in grass. The transformation effected on this land reflects the greatest credit on the management. Another case is that of a farm of 250 acres in Kent, which was entered on in March, 1917, and was in such a bad state that it was reported to be not worth cultivating. The farm was inspected in August, 1918, when it was found that 47 acres were under wheat, 15 acres under oats, 25 acres under barley, 14 acres under peas, 6 acres under clover hay, and 14 acres under vetches. This work was accomplished by the Committee with the minimum of expense, and even better results are expected this season.

When giving up a farm which has been entered, the Ministry has a statutory right to recover the value to the owner or an incoming tenant of the improvements effected; in a few cases this may amount to some thousands of pounds. The policy of the Ministry is to withdraw from possession subject to this right, provided that satisfactory arrangements are made for carrying on the cultivation of a farm, either by the owner himself or by a tenant, and a number of Agricultural Executive Committees are now withdrawing from land of which they had taken possession. In the case of Cheshire, for instance, the

Agricultural Executive Committee has since the beginning of this year withdrawn from 705 acres out of a total of 812 acres that were either being farmed by the Committee or were let by them to farmers at the end of 1919. The Ministry is still in possession of about 35,000 acres of land throughout the country, and in exceptional cases the power to enter on land which is either derelict or is badly farmed is still being exercised. The power under the Defence of the Realm Regulations will lapse in the near future, but Part IV. of the Corn Production Act, 1917, provides similar, though somewhat less drastic, powers. The Ministry is delegating its powers under Part IV. of the Act to the same Committees which functioned under Regulation 2M. Eventually these powers will be delegated to the County Agricultural Committees that are now being set up under the Ministry of Agriculture and Fisheries Act, 1919, and the enforcement of good cultivation will then become a branch of the county administration.

DURING the year 1919 eight Orders under the Land Drainage Act, 1918, establishing new drainage authorities or extending the area of existing drainage authorities, were finally confirmed, the total area brought under their jurisdiction being 31,000 acres.* During the present year the Ministry has finally confirmed three similar Orders affecting a total area of, approximately, 22,000 acres. In addition, five draft Orders, concerning about 24,000 acres, have been deposited for public inspection, while two Orders affecting 37,000 acres have been sealed by the Ministry and now await final confirmation. There is reason for hoping that the Orders which have not yet been finally confirmed will become operative without any serious opposition.

Mention has already been made in this *Journal* (March, 1920, p. 1172) of a Provisional Order which the Ministry has settled and made, establishing a single authority for the whole of the drainage area of the Great Ouse and its tributaries, comprising 480,000 acres. The great size of this area, and the difficulties of reconciling the numerous interests concerned and of arriving at an equitable system of rating for the expenses of the Drainage Board, have been such as to render it necessary to submit the Order to Parliament for confirmation.

* A review of the work of the Ministry under the provisions of the Land Drainage Act, 1918, was published in this *Journal*, February, 1920, p. 1088.

Numerous applications have been received by the Ministry from drainage authorities for Orders increasing their rating and borrowing powers on the ground that the powers conferred by their local Acts are insufficient for the performance of their duties under post-war conditions. Since 1st January last, three Orders of this kind have been confirmed, and four others are expected to be confirmed shortly.

An Order has been confirmed transferring to the Lancashire County Council the powers and duties of four bodies of Drainage Commissioners in Lancashire; it is the only Order of this nature that has been made.

The Ministry has in hand the preparation of between 30 and 40 Orders establishing new drainage districts. These figures afford striking testimony to the need that existed before the passing of the Act of 1918 for the establishment of drainage authorities and also to the effectiveness of the machinery provided by that Act. The Ministry's policy is to treat whole river systems as administrative units, and to place each system under a single authority, experience having proved that where authorities having jurisdiction over parts only of a river system have been established, engineering and administrative difficulties have frequently arisen rendering effective drainage impossible.

* * * * *

WADFAST MOOR is situated near Launceston, Cornwall, about 500 ft. above sea level. During the last 100 years the land has fallen out of cultivation, and it is now covered with heather, gorse, sedges, rushes, and various forms of marshland vegetation. In places it is also badly waterlogged. The surface soil is mainly a dark-coloured loam from 5 to 8 in. deep, which rests on a subsoil of yellow clay. It is very sour and was found on analysis to contain a high percentage of organic matter, but relatively small amounts of available phosphate.

**The Cultivation
of a Moor
in Cornwall.**

With a view to testing the possibility of growing oats on this type of land, the Cornwall Executive Committee decided, in 1918, to break up about 80 acres. Ploughing was commenced on 16th July, with Titan and Mogul Tractors and Davey-Sleep 2-furrow balance ploughs. At first an attempt was made to plough up and down the slope to facilitate drainage, but, owing to the tough nature of the turf and the rank herbage, the plough failed to turn the furrow. It was decided, therefore,

to plough across the slope, commencing at the bottom. The furrows, which were about 11 in. wide, and 6 to 7 in. deep, were all turned one way, to ensure the complete inversion of the sod.

The difficulty of securing adequate drainage was surmounted by using a Case Road Grader imported from the United States. This implement is widely used in the United States and the Dominions and was found quite effective for making open drains. It may also be usefully employed in cleaning out existing open drains and ditches.

After ploughing, the land was rolled twice, in order to ensure that the herbage should remain buried as far as possible. It was then twice disc-harrowed.

At this stage the land was allowed to lie fallow for 9 months until the following April, receiving no treatment except an application of lime at the rate of $1\frac{1}{2}$ tons per acre. It was then again disc-harrowed twice with a Fordson tractor. The Committee decided to try seven different kinds of oats, a plot being set aside for each kind. Each plot was divided into three sections, in order that manurial tests could be made at the same time. The first section was manured with a mixture of 5 cwt. superphosphate and 1 cwt. sulphate of ammonia per acre (mixture "A"); the second with 3 cwt. superphosphate and 1 cwt. sulphate of potash per acre (mixture "B"); and the third was left unmanured.

Sowing was carried out during the middle of May, at the rate of about 4 bush. per acre; this was rather late, owing to wet weather and a difficulty in obtaining seed. The seven varieties sown were Victory, Golden Rain, Potato, Yielder, White Canadian Banner, Cornish, and American Black Tartar, the last three being obtained from local sources. Yielder and Golden Rain gave the best crops, followed by Victory and Potato. Yielder, however, had the advantage of being the first seed to be planted, while Potato was planted last. The Cornish varieties were all very late in maturing, and, moreover, did not give very heavy yields.

As regards the effect of manuring, "A" mixture gave the best results, possibly owing to the effect of the sulphate of ammonia, which enabled the crop to make a good start before the dry weather set in. "B" mixture gave fair results, the straw being of good length, but the crop was neither so thick on the ground nor so heavy in the ear as in the case of the "A" mixture plots. The unmanured sections in every case gave poor results.



FIG. 1 - Showing that no crop was harvested on the portion not manured.



FIG. 2 - Showing Golden Rain growing on land manured with "A" mixture



FIG. 3 --Showing difference between ground manured with "A" mixture and that which was not manured.

It is interesting to note that although, as a general rule, the application of lime in Cornwall is supposed to have a harmful effect on oats, yet in these experiments no injury seems to have been caused to the crop, where lime was used in conjunction with other manures. In the sections which were limed, but otherwise unmanured, the oat crop was a total failure. As, however, the action of lime is slow-working in its effects, it is probable that the beneficial results of the liming would be noticed more in the 1920 season.

The results of the experiment seem to point to the value of certain early maturing varieties such as Yelder and Golden Rain for sowing in late districts, and further to the importance under such conditions of artificial manures, particularly superphosphate mixed with some sulphate of ammonia, for stimulating growth and hastening maturity.

The above experiment was initiated and supervised by Mr. Charles Nairn, Honorary Tractor Representative for Cornwall, and there is included in this account information communicated to the Ministry by Mr. W. Borlase, County Organiser.

* * * * *

AN investigation was undertaken by the Ministry of Food into the average cost of producing 1 lb. of butter on nine farms near Penzance for the week ending 26th February, 1920.

**Cost of Butter
Production.**

As the estimated average cost of producing 1 gal. of milk was found to be 3s. 0½d., the average cost to produce butter, after allowing 6d. per gal. for skimmed milk, was estimated to be 5s. 0½d. per lb. during the period of investigation.

Five farms (marked X on the subjoined table) were nominated by representatives of the National Farmers' Union, and four farms were nominated by representatives of the Dockers' Union on behalf of the miners.

A representative of the Ministry of Food visited each farm for the purpose of obtaining full data in regard to the number of cows dry or in milk, the amount of milk produced, and the quantities and kinds of food fed to the cattle. It is to be regretted that the farmers themselves were neither aware of the total quantities of foods fed nor of the proportion given to the cows that were in milk or were dry, for which reason it has been an impossible task to arrive at the exact cost of production, although the conclusion arrived at may be regarded as approximately accurate.

For the purpose of this investigation, the market value of home-grown produce has been disregarded (with the exception of cereals), the estimated cost of production alone being taken into account as follows :—

Hay	£7 per ton.
Straw	50s. „
Roots	27s. „
Home-grown cereals at two-thirds of their market value and purchased concentrated foods at market value.	

Labour has been based on the current local rate of wages.

No manurial value has been taken into account, because almost all foods were found to be home-grown.

The value of calves is almost exactly off-set by the cost of repairs, miscellaneous items, and delivery charges, and for this reason these items are not taken into account in the accompanying table. The value of grazing in cases where the cows were obtaining enough grass to effect a decrease in the ration fed was taken at 2*d.* per cow for the week, an estimate based on an annual rental of 50*s.* per acre per annum.

Depreciation has been estimated at the rate of £5 per cow per annum, to cover losses by death and disease and the difference between the purchase and sale price of animals bred or brought into the herd annually in order to maintain it. In the case of farm C no depreciation has been allowed, as pedigree stock is bred on this farm and enhanced prices are obtained for calves and for animals sold from the herd.

The average percentage of butter-fat content was 4·6 per cent., an unusually high percentage, due to the breed of cattle. As butter contains about 86 per cent. of butter fat, 2 gal. of this milk is converted into slightly more than 1 lb. of butter and slightly less than 2 gal. of skimmed milk. As there is a local market for skimmed milk at 6*d.* per gal., an allowance for this by-product has been made at this rate.

The proportion of dry cows to those in milk is unusually high, being 123 dry to 103 in milk. This is no doubt due to the natural desire of the farmers to produce butter during the summer when the cost of production is comparatively low, rather than during the winter, when the cost is high. This low proportion of cows in milk materially increases the cost of production above what it would cost in winter were the same proportion of cows in milk to those dry to be maintained during the winter and summer periods alike.

Summary of Cost of Milk Production.

	X A	X B	X C	X D	X E	F	G	H	I	Total	Average.
Number of Cows:											
(a) In Milk ..	16	18	9	10	13	13	5	8	11	103	11.4
(b) Dry ..	12	11	26	18	6	13	8	12	17	123	13.7
Total ..	28	29	35	28	19	26	13	20	28	226	25.1
Total number of gal. produced per day ..	gal.	gal.	gal.	gal.	gal.	gal.	gal.	gal.	gal.	gal.	gal.
Average daily yield per cow in herd ..	20	29.33	13.8	16	18	11	14.5	12	21	155½	17.4
Average daily yield per cow in herd ..	71	1.01	.39	.57	.95	.42	1.12	.60	.75		.69
Average daily yield per cow in milk ..	1.25	1.63	1.53	1.60	1.38	.85	2.90	1.50	1.91		1.51
Cost of production per gal. for all cows in herd.	per gal.	per gal.	per gal.	per gal.	per gal.	per gal.	per gal.	per gal.	per gal.	per gal.	per gal.
(a) Labour ..	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.
(b) Food ..	6.10	4.38	4.17	4.81	6.72	5.55	4.27	6.0	3.76	5.08	5.08
(c) Grazing ..	16.80	23.53	23.76	22.15	21.31	37.40	25.79	31.45	36.87	26.56	26.56
(d) Depreciation	4.30	.29	5.07	.45	.31					1.16	1.16
Total cost per gal.	4.65	3.28	—	4.50	3.51	3.79	3.00	5.55	3.13	3.42	3.42
Average Fat Analysis	4.3%	4.44%	4.9%	4.6%	4.3%	4.8%	4.7%	4.6%	4.5%	4.59%	4.59%

Notes.—A, B, C, D, E.—Farms nominated by National Farmers' Union.

F, G, H, I.—Farms nominated by Miners' and Dockers' Union Representatives.

In the case of Farm C, a deduction of one half the amount of concentrated foods used was made as the producer was fattening or preparing his stock for the pedigree market.

(The National Food Journal, 10th March, 1920.)

The general shortage of foodstuffs during the period of the War drew the attention of the authorities to the great waste of whey that was taking place throughout the country. Owing to the fact that the present system is to collect milk at depots for the manufacture of cheese, large quantities of surplus whey have been allowed to run to waste. This has not only been a great loss to the nation's food supply but has also constituted a public nuisance by disorganising the treatment of sewage, and contaminating water courses (to the detriment of public health) and in some cases causing loss of live stock. Many thousands of pounds sterling have been lost annually in this way.

Whey is in itself a valuable food both for human consumption and for stock. When used as part of a ration pigs thrive on the food, and calves can also be reared on it satisfactorily,* but at the centres where there is the largest amount of whey

* See article in this Journal, April, 1919, p. 39.

available, a far greater number of stock would be required for its consumption than can be dealt with conveniently. It therefore becomes evident that it must be converted into such products as can be utilised for human food.

Whey contains a certain amount of butter fat, and this should be separated as soon as possible after the whey has been run from the curd. The amount of fat varies according to the method of manufacture, but usually 2 lb. to 3 lb. of butter can be made from 100 gal. of whey from factory-made cheese. With the exercise of proper care quite good butter can be made, but in the absence of such care the product may possess a peculiar flavour.

After the removal of the fat, the separated whey can be treated for the separation of lactalbumen, which is a valuable food.

After the separation of the lactalbumen, the whey can be evaporated and further treated for the separation of the milk sugar (lactose). Lactose, of which this country has hitherto imported the greater part of its requirements, is used largely in the manufacture of infants' and invalids' food and also for medicinal purposes and products.

* * * * *

Progress continues to attend the efforts being made to induce County Education Authorities to pay attention to the general improvement of the standard of milk production in their areas. A number of counties are providing lectures and demonstrations in clean milk production.

**Increased Milk
Production in
Cornwall.**

As an instance of the effect of Co-operative Cheese Schools in encouraging local increases in milk production, a report lately received respecting the activities of the Camelford and District Co-operative and Dairy Society may be quoted.

Camelford is a district in North Cornwall where very little milk was produced previous to 1917, in which year a co-operative school was held at Camelford. This school resulted in the formation of a co-operative society; and the following are the data showing the quantities of milk dealt with:—

	1917	..	..	..	..	30,000 gal.
▲	1918	..	..	..	..	64,000 "
	1919	..	..	..	..	108,000 "

It is claimed that the increases in the quantity of milk dealt with by the Society are entirely attributable to increased cow-keeping in the district, and it is further reported that not-

withstanding the fact that the milk was either sold as milk or made into dairy produce, the number of stock raised in the district has also been increased; and the whole is taking place without any reduction in other farm produce.

* * * * *

THE Food Controller, after consultation with the Ministry of Health and the Scottish Board of Health, has hitherto granted licences permitting the use of the designations Grade A and Grade B in connection with the sale of milk of high hygienic quality. All such licences lapsed on 14th March, 1920, and from that date the arrangements described below came into operation.

Under the terms of the Milk Order, 1920, the Food Controller has required that no person shall, on or in connection with any sale or offer for sale or proposed sale of any milk or in any advertisement, circular or notice relating to any milk, describe or refer to the same as Grade A (Certified) Milk or Grade A Milk, or use any designation of which the words Grade A (Certified) Milk or Grade A Milk form part, except under licence by the Ministry of Food.

The Food Controller is prepared to grant licences, permitting the use of the designations Grade A (Certified) Milk and Grade A Milk, provided that the milk in respect of which a licence is sought by the producer or the wholesale or retail distributor complies with certain conditions to the satisfaction of a representative of the Ministry of Health or of the Scottish Board of Health, or of any local authority acting on behalf of the Ministry of Health or of the Scottish Board of Health; who will undertake the inspection of farms and other premises, An Inspection Report Card (H.M.L. 7) will be used in connection with the inspection of farms, and a minimum percentage of points will be necessary to qualify for licences.

All communications with reference to the matter should be addressed to the Secretary, Ministry of Food, 100, Cromwell Road, London, S.W. 7.

* * * * *

THE issue of the *Journal of Dairy Science* for September last contains an account of the electro-pure process of treating milk as a substitute for the more usual practice of pasteurisation as a means of preservation. This process makes use of a high voltage electric current for destroying organisms present in the milk and so enhancing its keeping

**Electro-pure
Process of Treating
MILK.**

properties. It is stated that the machine when operated under regular conditions will give the desired results, but that for commercial purposes the product was not uniformly satisfactory, and that it was considered necessary for constructional modifications to be made in the machine before it could come into general use.

The following is a summary of the conclusions arrived at by the experimenters :—

1. The electro-pure process conducted under the conditions indicated in these experiments gives a very satisfactory reduction in the number of bacteria in good raw milk, and a satisfactory reduction in poor raw milk, and at the same time effectively destroys nearly all lactose-fermenting, endo-positive organisms in raw milk.

2. Milk issuing from the different units of the electro-pure machine is fairly uniform in bacterial count.

3. Electro-treated milk kept at 5° to 10° C. keeps well for about five days.

4. At room temperature electro-treated milk showed no change in 24 hours, but soured normally in 48 hours.

5. The destruction of bacteria in the electro-pure process is apparently due to the heat produced by the electric current rather than to the electric current itself. The electro-pure process furnishes a method for producing a very sudden high temperature for a brief period of time.

6. The precipitation of albumen by the electro-pure process at 70° C. is very slight, if any.

7. The time required for coagulation by rennin is decidedly increased after treatment by the electro-pure process at 70° C.

8. The electro-pure process at 70° C. apparently does not destroy the peroxidase in milk, but weakens the reductase.

9. The electro-pure process has no effect on the feeding value of milk.

10. From a practical standpoint the electro-pure machine in operation at this plant has not proved entirely successful in the long run. Modifications in construction must be made before the machine can be regarded as a commercial success.

* * * * *

Need for Increased Production.—In 1919 there were 2,914,000 pigs in the United Kingdom. On the basis of the consumption in that year, it is estimated

The Pig Industry. that the number quoted would have to be increased by 6,700,000 (making a total of 9,614,000 pigs) to make the United Kingdom self-supporting in bacon and hams. The number reared in this country has seldom

exceeded 4,000,000 and is usually between 3,000,000 and 4,000,000 head. During the War, the pig stock in Continental countries was seriously diminished in numbers, and, prolific as the pig is, it will probably take two or three years at least for those countries to restore their stock of pigs to anything like their pre-war level. Denmark was one of the main sources of supply before the War, but it will be some time before exportation from that country approaches its former level. There is, therefore, every reason why cottagers and farmers in this country should increase their production of pigs. Pig keeping should, however, be conducted on an organised scale, particularly so far as cottagers are concerned. The Rural Industries Branch of the Ministry is showing how this organised effort may be made, and full particulars can be obtained on application to the Director of Rural Industries, 4, Whitehall Place, London, S.W. 1.

Grants for Boars.—Several pig insurance clubs in different parts of the country have recently approached the Ministry, which is advising clubs (already existing or in process of formation) as to the need of improving the breed of pigs.

A properly constituted society in promoting pig breeding may follow either of two methods :—(a) it may purchase a boar and place it in the custody of a club member ; or (b) the society may arrange with an owner—who need not necessarily belong to the club—to place his boar at the society's disposal on terms agreed. The owner must guarantee the service of not less than 20 sows belonging to members. Such owner will be entitled (1) to a payment from the society of not less than the amount of the grant from the Ministry, (2) to a fee of not less than 1s. per sow served ; and (3) to have not more than 6 of his own sows served by the boar, unless a greater number is sanctioned by the Live Stock Officer.

* * * * *

DURING the year 1913, nearly 144,000 tons of eggs, valued at over £9,500,000, were imported into the United Kingdom, in addition to nearly 14,000 tons of dead

Poultry and Eggs. poultry, valued at nearly £1,000,000. At present-day prices, the value represented is over £30,000,000. In 1919, the imports of eggs were less by 100,000 tons, and dead poultry by 6,000 tons, but over £7,000,000 of dried and preserved liquid eggs were imported, mainly from China, as compared with only a negligible quantity in 1913. From Ireland Great Britain imported eggs and poultry during 1919 to the value of probably over £18,000,000. The grand total

of the imports of these two commodities by Great Britain during 1919 was, therefore, approximately £35,000,000.

The extensive import trade indicated by these figures should cause British farmers, small holders, allotment holders and even city dwellers to consider the prospects of developing the present home production of eggs and poultry, which is much below what is possible. In 1908, the latest year for which figures are available, the number of adult hens in Great Britain on holdings of one acre and upwards was nearly 17½ millions. There were, of course, in addition, considerable numbers kept by occupiers of less than one acre of land and by town residents.

An acre of pasture land will carry in addition to the ordinary farm stock—horses, cattle or sheep—at present grazed upon it, at least three laying hens, which will not interfere with the grazing of the other stock but will actually increase the growth of herbage. If suitable portable houses are used for the hens, and if they are removed to the corn stubbles in autumn and left there while cultivation is carried on until just before the seed for the succeeding crop is sown, the birds will find from 25 to 50 per cent. of the food they require in the form of grubs, worms, waste grain, etc. In addition, their manure will improve the soil and the birds will help to remove injurious grubs from the land.

Under semi-intensive conditions, *i.e.* where large laying houses are used providing 3 to 4 sq. ft. of floor space for each bird, from 200 to 400 hens may be kept on an acre of land, provided the land is properly cultivated, cropped and kept in sweet condition. The crops grown are usually forage crops, such as thousand headed kale, which provide necessary green food for the hens, and sometimes the runs are planted with bush fruit or standard fruit trees.

The town dweller also has opportunities for poultry keeping, and he possesses two special advantages: (1) eggs produced in the backyard can be distributed more easily, and involve little or nothing in transit charges; and (2) the householder's food scraps are put to an economic use, and reduce considerably the cost of feeding the hens. In a properly-constructed intensive house providing about 4 sq. ft. of floor space for each bird, country-reared pullets can be maintained under a proper system of feeding and management in healthy productiveness for at least a year, even though the birds may have no outside run whatever. Any town dweller with a small back garden can thus maintain a few laying hens in order to produce new-

laid eggs for his own table. Unless ample ground is available, however, it is better for the town dweller not to attempt rearing; he should purchase his pullets from a breeder in the open country.

It is essential that in every case a proper system of housing, feeding and general management should be studied and practised in order to obtain profitable results. One important factor necessary to success is that only hens that are bred from strains having a high egg-yield should be kept. There is a wide difference in the egg-producing capacity of individual hens, but the average yield from a flock of birds bred from carefully selected ancestors will invariably be greater than that obtainable from a flock of nondescript mongrels, given the same feeding and management. In view of the importance of this question the Ministry has, in conjunction with about thirty-eight County Local Authorities, arranged for the distribution, at moderate prices, of eggs for hatching and day-old chicks from high-class stock, at about 213 breeding centres in England and Wales, in order that poultry keepers who may not be in a position to pay high prices may have an opportunity of rearing good breeding stock for next year.

AN egg-laying competition was held by the Northern Utility Poultry Society during 1918-19 on the Society's farm at Towneley, Burnley. The competition was divided into four sections, viz., Section 1 (White Leghorns), Section 2 (White Wyandottes), Section 3 (any other variety), and Section 4 (limited to small breeders, and in which White Wyandottes, Sicilian Buttercups, White Leghorns, Buff Rocks, and Rhode Island Reds entered). In all 107 pens of pure-bred poultry competed, and 5 pullets of one breed were allowed to each pen. The birds in Sections 1, 2 and 3 were kept in houses 12 ft. by 8 ft., divided in the centre, with grass runs, and those in Section 4 were housed in large runs.

The eggs laid were separated into three grades, according to weight, but only the two first grades were given a score value. Eggs weighing 2 oz. and over were classified as Grade 1, and those weighing during the first ten weeks less than 2 oz. but not less than 1½ oz., and for the subsequent period of the test not less than 1½ oz., were classified as Grade 2; not more than 100 second-grade eggs, however, were allowed to be

included in the pen score for competition purposes. The eggs for which no score value was allowed were placed in Grade 3.

The food during the test consisted of grain fed in the litter each morning, dry mash in hoppers at the manager's discretion, and wet mash in the afternoon.

The three highest scores in each section, over a period of 48 weeks, were as follows:—

			Total Eggs.	Score Value.
Section 1 (White Leghorns)	1st	.. ..	1,144	1,082
	2nd	.. ..	1,091	1,045
	3rd	.. ..	996	996
Section 2 (White Wyandottes)	1st	.. ..	1,099	916
	2nd	.. ..	909	909
	3rd	.. ..	920	863
Section 3 (any other variety)	1st (Rhode Island Red)		966	966
	2nd (Black Leg-horns)	1,015		962
	3rd (Anconas)	.. 791		791
Section 4 (small breeders)	1st (White Wyandottes)	947		947
	2nd (White Leg-horns)	921		921
	3rd (White Wyandottes)	907		907

* * *

TRACTOR TRIALS are being promoted by the Royal Agricultural Society and the Society of Motor Manufacturers and Traders. The entries are divided **Tractor Trials, 1920.** into seven classes. Three of these are for internal combustion tractors, one for steam tractors, two for cable ploughing sets (steam and internal combustion engines respectively) and one for "self-propelled ploughs." For each class a first prize of a gold medal and £20, and a second prize of a bronze medal and £10 are offered. The competitive aspect of the trials is, therefore, very pronounced, and the conditions of the trials will necessarily be in sharp contrast to those in force at Lincoln last year.* It remains to be seen whether the present method has any advantage over that adopted last year by the Society of Motor Manufacturers and Traders; but in any case opportunity will be provided for testing the two most obvious methods of conducting trials of short duration.

* The general principles in regard to the judging at these trials are stated in the Report on the Lincoln Tractor Trials for 1919, a note on which appeared in last month's issue, p. 1174. An account of the trials was published in this *Journal*, October, 1919, p. 686.

THE attention of farmers is directed to two recent cases of Anthrax which have a most important bearing on the dangers of employing shoddy as manure. British **Shoddy as Manure:** shoddy is comparatively safe, but foreign **Danger of Anthrax.** samples are likely to contain and disseminate the Anthrax spores. Farmers should use only shoddy guaranteed to contain no foreign element, or to have been properly disinfected.

In one case two sows died of Anthrax on a sewage farm. The farm land received from a neighbouring fleece-factory sewage mingled with the chemicals used in treating fleeces. The chemicals do not destroy the spores which may be present in the fleeces, and any infected sheep-skin would be a source of risk. The factory, though dealing chiefly with British fleeces, had recently received large consignments from abroad, including a quantity from South America. There is a strong presumption that these fleeces were the cause of the outbreak.

In the other case two cows fell ill. One was slaughtered and the other died under strong suspicion of Anthrax. Shortly afterwards a man who had handled the carcass of the slaughtered beast developed undoubted Anthrax. Both cows had been fed on mangolds and turnips grown on fields manured with shoddy. These two cases are sufficiently instructive.

* * * * *

AN extremely interesting experiment in village organisation is being made in the parish of Compton in Hampshire on the lines recommended by the Village Clubs Association. Situate amid the chalky Downs of Hampshire, and several miles from a railway station, the local residents have decided that the best way of improving the social and material conditions of the parish is by grouping all the village clubs and societies under a Central Council. The method adopted is to appoint representatives from each of the village organisations on the Central Council. Separate accounts will be rendered to the Council annually, and financial help will be given to any clubs or societies requiring it, the subscriptions made to the Council by local landowners and others interested being used for this purpose. The idea is not only to co-ordinate activities in the village, but also to give help where it is most needed. For example, the football club may find itself at the end of the year with a credit balance, while the cricket club may be slightly in debt. In such a case, financial assistance will be given to the cricket club to prevent its collapse. Similarly, a live-stock association will receive help, if needed, from the

same source. No attempt will be made to pool the funds of the various societies; a separate account will be kept of the finances of each organisation; local residents are entering with enthusiasm into the movement; and there is every prospect that the experiment will prove a model for adoption in other villages.

* * * * *

THE value of seaweed as manure is appreciated in many parts around the coasts of the British Isles. It is specially valued in Cornwall and Devon for early potatoes, cauliflowers and root crops; in the Isle of Thanet for lucerne, sainfoin, market-garden crops and ordinary farm crops; and in Jersey for early potatoes.

**The Value
of Seaweed as
Manure.**

The use of fresh and dried seaweed on all farms near the coast during the present scarcity of farmyard manure is worth considering. Some species contain as much nitrogen as farmyard manure (although in a more slowly-acting form), and more potash, but less phosphate, so that it is advisable to add a phosphatic manure when seaweed is used instead of farmyard manure. It should be put straight on the land, or else mixed with dung or other material which will absorb some of the decomposition products.

Fresh seaweed cannot economically be used as manure at any great distance from the coast, as the expense of carriage of so bulky a product would make the cost prohibitive. To be used at all on inland farms it would either have to be dried and ground, or else burnt. It seems possible that the collection and burning of *Laminaria* and *Fucus* might repay attention.

Detailed information with regard to the composition and use of seaweed for manurial purposes is given in the Ministry's Leaflet No. 254.

* * * * *

IN view of the shortage of potatoes, control of prices has recently been re-imposed by the Ministry of Food.

The maximum growers' price for ware potatoes (*i.e.*, potatoes which will not pass through a $1\frac{1}{2}$ in. riddle) was fixed at £12 15s. per ton f.o.r. during the period 15th to 31st March, and thereafter the growers' prices were to increase fortnightly by 5s. per ton, rising on 1st June to £14 for the remainder of the 1919 crop. For potatoes other than ware potatoes, or for a mixture of ware and other potatoes, the maximum growers' price is £8 f.o.r. irrespective of the date of delivery.

Wholesale dealers will be permitted to average their profits in the same way as last year. The average profit over all transactions during the fortnightly period ending 28th March and each subsequent fortnightly period must not exceed 7s. 6d. per ton, where the potatoes are sold to another wholesale dealer, and must not exceed 15s. per ton where the potatoes are sold to a retail dealer or consumer. In addition, the wholesale dealer may charge any reasonable amount borne by him in respect of transport, and a sum not exceeding 10s. per ton for bags where these have been supplied by him.

The maximum growers' prices apply only to potatoes grown in Great Britain, and the Order does not prescribe any maximum first-hand price for potatoes imported from Ireland or foreign countries. On the other hand, the limitation of profits of wholesale dealers applies to all potatoes sold in Great Britain, whether home-grown, or imported.

The Order does not extend to Ireland, and does not apply to potatoes sold as or for seed. In the case of potatoes sold for seed, the provisions of the Seed Potatoes Order, 1918,* must be observed.

All contracts (other than contracts for sale of potatoes in the ground) for the sale of potatoes subsisting on the date when the Order came into force (15th March, 1920) are cancelled, except in respect of potatoes delivered before that date.

* * * * *

EVERY effort made by farmers this year to increase the acreage under corn as well as to obtain a better yield per acre

will be for the nation's benefit. To
 "Smut Diseases" of Wheat, Barley and Oats. achieve a better yield, much can be done by using only seed that is of good quality and is free from disease.

Some of the most common cereal diseases are the "Bunt" or "Stinking Smut" of wheat; the "Covered Smut" of barley; and the "Loose Smut" of oats. So widespread are these becoming that probably every farmer is familiar with the appearance of the black, powdery spores which, adhering to clean grain carry infection over from year to year. Fortunately, infection can be prevented by dressing or "pickling" the seed before sowing.† For "Stinking Smut" in wheat, a solution of 1 pt. of commercial formalin and 20 gal. of water is the best preventive: or a solution of 1 lb. of copper sulphate (bluestone) of 98 per cent. purity and 10 gal.

* See this *Journal*, January, 1919, p. 1235.

† See also this *Journal*, October, 1918, p. 850, and December, 1919, p. 907.

of water might be used, though this is apt adversely to affect the germination of the seed. The solution may be poured over the grain spread over the barn floor, or the seed may be emptied into the vessel containing the solution and allowed to "steep" for 10 or 15 minutes. A slightly weaker solution of formalin, 1 pt. to 25-30 gal. of water, may be used as a preventive against "Covered Smut" in barley and "Loose Smut" in oats, but the duration of the soaking *should not exceed* 10 minutes. If the seed cannot be sown within a few hours after "steeping," it should be spread out on the barn floor in a current of air and thoroughly dried. The general adoption of these measures throughout the country will lead to a marked improvement of corn crops both in quality and quantity.

* * * * *

ONE of the worst, and at the same time the least often recognised, of wheat pests is the Wheat Bulb Fly (*Hylemyia coarctata*), stated to be now prevalent in Dorset. This pest is almost always responsible for considerable "thinning" of winter wheat during the spring, notably perhaps in East Anglia. Occasionally, however, it appears in sufficient numbers to cause an epidemic, when whole fields of wheat may be destroyed. Such an epidemic occurred in Cheshire in 1917.

The damage is caused by the maggot (or larva) of the fly which feeds within the growing shoot of the wheat. Each attacked shoot is killed, with the result that if the wheat is weakly or the maggots are very numerous, the whole plant dies. It should be noted, however, that if the wheat does not actually die, considerable recovery is possible owing to the powers of the plant to put out fresh tillers. A field which now or later looks very "seedy" may produce a very fair crop, and it is therefore unwise to decide too soon on ploughing. Naturally anything which can be done to stimulate rapid growth will increase the chances of recovery. With regard to re-sowing, barley is probably the best cereal to choose, since it is not attacked by the fly, and sowing can be deferred until it is clear that there is not sufficient wheat left to make a crop.

The habits of the fly are still not fully known, and hence it is difficult to advise other treatment. The maggots now feeding will turn to pupae (or chrysalides) in the soil, from which the flies will emerge in June. These flies live some weeks.

* See also note on p. 37.

but where they lay their eggs and what happens to the pest from July until the maggots are found in the following spring are problems which have not been solved. One thing seems clear, and that is that the nature of the crop preceding wheat has a definite influence. Wheat following potatoes, for instance, seems specially liable to attack, and the same is said, though with less evidence, of wheat after bare fallow. Further observations on this subject are very desirable.

* * * * *

The Planting of Early Potatoes in "Infected" Areas.—The Ministry of Food recently estimated that, at the then rate of

**Wart Disease of
Potatoes.**

consumption, the remaining supplies of eating potatoes from the 1919 crop would be exhausted before the new potatoes for the 1920 crop are available. It is anticipated that in consequence there will be a very heavy demand on the latter as soon as they appear on the market, and it is desirable that the acreage planted with first early varieties be increased to the largest extent possible.

The possibility of such a situation had already been fore-shadowed, and growers in the Eastern and Southern Counties have responded to it in a very laudable manner, large quantities of first early varieties being planted. Growers occupying land within those areas in which wart disease is widespread and common pointed out, however, that their willingness to co-operate was hindered by the marked shortage of stocks of first early immune varieties.

The Ministry, after careful consideration of this question, decided as a temporary measure to issue general licences authorising the planting in infected areas of *own-saved* "seed" of *any* true first early variety and also of those varieties recognised by the Ministry as of the "Eclipse" type, provided that they are planted on land on which wart disease has not occurred, and that they are grown and lifted as first earlies. Potato growers will not require individual licences for such planting. This concession does not extend the list of early varieties allowed to be introduced under licence by *bona-fide* market growers for planting in infected areas.

It was reported from many parts of the Midland Counties that, when sprouted and planted early, the second early immune variety "King George" grows quickly and can be marketed practically as early as "Epicure." "Seed" of "King George" was plentiful and its price much lower than that of first early varieties.

Certified and non-certified Stocks of Immune Varieties.—To prevent the introduction of any "seed" potatoes other than true and pure stocks of immune varieties into those areas infected with wart disease, the Ministry recently restricted such introduction to those stocks which had been inspected during growth and certified as satisfactory in those respects. The notification of this policy was, however, accompanied by the announcement that should the supplies of certified stocks be found insufficient to meet the demand, the Ministry would be prepared to licence certain non-certified stocks.

The results of careful investigation seemed to show that the certified stocks of "Golden Wonder" and "Kerr's Pink" were becoming exhausted, and the Ministry is, therefore, prepared to grant licences for the introduction into infected areas of non-certified stocks of these two varieties.

Applications for licences should be made to the Secretary, Ministry of Agriculture and Fisheries, 72, Victoria Street, London, S.W. 1. In the case of stocks grown in England and Wales, the potatoes will be examined before licences are granted. In the case of stocks from Scotland, licences will be granted subject to the inspection of the seed upon arrival at its destination, and without prejudice to any action the Ministry may think fit to take as the result of such inspection.

Merchants have been reminded that in the case of any sale of certified stocks or of licensed non-certified stocks, the relative certificate or licence number must be given to the customer in the invoice or other written document.

THE technical advisers of the Ministry are giving careful attention to the question of preventing the introduction into this country of insect pests and plant diseases from abroad.

Insect Pests and Plant Diseases.

Several countries already possess the safeguards lacking in England; for instance, the United States and Cape Colony prohibit altogether the importation of plants except under special permit. Such a policy, if adopted in this country, would present obstacles to the development of agriculture and horticulture and would probably not meet with the approval of growers; while the alternative plan of placing potentially dangerous host plants in quarantine for a definite period is open to criticism on the grounds of expense and delay. The quarantine system, however, has many good points and might with advantage be adopted in this country. In any case, a system of inspection at ports of entry might be

made. In the case of imported gooseberries, such a system of inspection led to the adoption of a somewhat similar method of inspection by exporting countries, resulting in the despatch of much cleaner fruit to this country. If similar steps were taken in regard to nursery stocks arriving here from abroad, there would be good reason for expecting an improvement in quality and cleanliness. In addition, the danger of epidemics arising from the introduction of foreign plant enemies would be considerably lessened.

* * * * *

AN account was published in the issue of this *Journal* for October last, p. 725, of the work of the Flax Production Branch of the Ministry with a view to encouraging the home cultivation of flax. An article published in the issue of the *Journal of the Board of Agriculture for Scotland*, October, 1919, gives a brief account of the work of the Flax Production Branch in 1918 in regard to the Fife centre (of about 1,300 acres) in Scotland, and contains some interesting facts in regard to the composition of the crop of seed produced.

It is stated that although the crop in Scotland was grown with the object of producing fibre, the seed also was saved, and the opportunity was taken of obtaining samples of the seed for analysis, particularly for the determination of their oil content, it being thought that it would be of interest to Scottish farmers generally to know what percentage of oil might be expected in seed grown in Scotland under these circumstances.

The Flax Production Centre issued full instructions* for the guidance of farmers prepared to grow flax in Fife, with the result that, within limits, the crop was raised under more or less similar conditions, more especially as to its place in the rotation, time of sowing and of harvesting, manuring, etc.

The seed supplied to the farmers was all from one source, being Dutch, a sample of which taken from bulk was found on analysis to have the following composition:—

Moisture	..	..	7'98	per cent.
Oil	..	..	39'20	
Albuminoids	..	..	22'19	
Fibre	..	..	5'33	
Ash	..	..	4'74	
Soluble Carbohydrates			20'56	

100'00

* See also note in this *Journal*, February, 1918, p. 1241.

The seed of the crops from which the samples of seed were obtained was sown broadcast either by hand or by machine at the rate of 126 to 140 lb. per acre in loamy soils that varied from light to heavy, and ranged in altitude from 100 to 560 ft. above sea level. The place of the crop in the rotation was in the large majority of cases after grass or grain stubble, and the manure applied consisted of 1 cwt. of sulphate of ammonia, with the addition in some cases of 2 to 3 cwt. of superphosphate of lime. All the seed was sown in the month of April and the crop harvested in August. Labour difficulties prevented the crop being harvested at the proper time in every case, with the result that on some of the farms the crop had gone a little beyond the required stage for fibre production at the time of harvesting.

The samples of seed received for analysis were of two kinds. The first represented linseed cleaned as far as it would be possible with the usual appliances that the farmer has at his disposal on the farm. A cursory examination of these samples showed that they varied greatly amongst themselves in the number of weed seeds they contained, and these on determination in the laboratory were found to make up from 2 to 14 per cent. by weight of the different samples, and to consist chiefly of *Polygonum Persicaria* (Redshanks), with dock, charlock, spurrey, and in cases a few Italian rye-grass seeds.

The following table gives the average percentage composition of 20 samples grown on different farms in Fife, together with the composition of the samples containing the minimum and maximum percentage of oil respectively :—

TABLE I.

—	Average of twenty Samples.	Sample contain- ing minimum Percentage of Oil.	Sample contain- ing maximum Percentage of Oil.
Moisture	12'35	12'40	12'96
Oil	32'49	27'50	37'50
Albuminoids	17'78	17'12	18'06
Fibre	7'43	9'00	6'50
Ash	4'12	3'40	3'74
Soluble carbohydrates ..	25'83	30'58	21'24

The wide variation in the oil content shown in the table is explained mainly by the presence, in different percentages in the different samples, of the weed seeds. A laboratory test was made as to the effect of the removal of these weed seeds

on the oil content, and it was found that in all the samples the removal of the seed raised the percentage of the oil content. Before removal, the average percentage oil content of the samples was 30·81; after removal, 34·60 per cent.

The second set of samples was finally-cleaned linseed, containing very few weed seeds, and the linseed themselves, having been graded in the cleaning, were much more even in size than was the case with the samples referred to in Table I.

The following table gives the average percentage composition of sixteen of these samples, together with the composition of the samples containing the minimum and maximum percentage of oil :—

TABLE II.

—	Average Percentage of sixteen Samples.	Sample contain- ing minimum Percentage of Oil.	Sample contain- ing maximum Percentage of Oil.
Moisture	8·66	9·00	9·06
Oil	36·15	34·74	38·55
Albuminoids	21·91	20·12	20·12
Fibre	6·78	6·00	5·95
Ash	3·75	3·60	3·78
Soluble carbohydrates ..	22·75	26·54	22·54

It will be seen that these samples differ but little in composition, the difference in the percentage of oil between the highest and the lowest being about 4 per cent. : the average percentage of oil in the 16 samples is about 36 per cent.*

A comparison of the average percentage of oil in the samples tested in the laboratory as to the effect of the removal of weed seeds on the oil content with the average percentage shown in Table II. shows that the latter is a little higher owing to the removal, in the mechanical cleaning, of the smaller and the less mature linseed as well as the weed seeds.

The article states that it has frequently been maintained and often used as an argument against the growing of linseed in this country that British climatic conditions do not allow of the growing of linseed with as high a percentage of oil as that contained in imported seed. This belief has been shown to be quite incorrect, for at a number of English centres the home-grown seed has contained as high a percentage of oil, and in cases even higher.*

* See this *Journal*, June, 1915, p. 255, February, 1916, p. 1071, and July, 1919, p. 420.

In this connection the figures for the Scottish set are of interest, the average of the 16 samples of seed being 36·15 per cent., and the highest for one sample 38·55 per cent., as compared with the figures of 39·20 per cent. for this sample of Dutch seed already given (p. 27).

The average yield of dressed seed per acre in the Fife centre was 15 bush. (of 52 lb. per bush.). Such a yield, of seed containing on an average 36 per cent. of oil from a crop grown for fibre production, suggests that it might be advantageous for the farmer to cultivate the crop for the sake of the seed required for his own use.* At present prices it is stated that there seems to be little doubt that, where possible, it would pay the farmer to grow the crop for seed consumption on the farm, for when grown for this purpose the seed might be greatly increased.

In addition to the seed, a valuable by-product is obtained in the process of de-seeding, known as linseed chaff, which consists of the capsules or receptacles in which the seeds are contained.

The following table gives the analysis of four samples of linseed chaff obtained from different centres in Fife, the yield of chaff being on the average 7 cwt. per acre.

TABLE III.

Percentage Composition of "Linseed Chaff" Capsules.

Moisture	12·40	12·24	14·40	13·45
Oil	4·40	7·59	6·85	6·72
Albuminoids	5·00	6·25	7·19	6·85
Fibre	31·75	32·15	33·65	31·55
Ash	7·96	9·73	8·20	8·81
Soluble carbohydrates ..	38·49	32·04	29·62	32·62
Total	100·00	100·00	100·00	100·00

The samples are seen to vary slightly in their percentage of oil, due to the fact that all the samples contained a few small linseeds, some samples containing more than others.

One factor which has tended to discourage the cultivation of flax on a large area of land well suited for the purpose in Scotland is stated to have been the belief that the crop was a particularly exhausting one. This belief, however, has been shown to be erroneous, and figures are given in the article showing that the weight of nitrogen, phosphoric acid and potash removed from the soil by the flax crop grown in Fife is just about the same as that removed by an average cereal crop.

* It is pointed out, however, that when growing flax for the seed it bears, a different variety of seed—namely La Plata—should be grown, the crop should be cut at a somewhat later stage of ripening. See *Journal*, February, 1916, p. 1069.

SINCE last month a correspondent has kindly sent a sample of flax chaff, which has been analysed with the following results:—

Notes on Feeding Stuff for May:	<i>Composition of Sample of Flax Chaff.</i>			
	<i>Per cent.</i>			
<i>From the Animal Nutrition Institute, Cambridge University.</i>	Water	..	..	12.0
	Protein	..	..	8.4
	Fat	..	..	5.6
	Carbohydrate	..	..	30.7
	Fibre	..	..	29.7
	Ash	..	..	7.6

This appears to be quite a useful feeding stuff, having approximately the same composition as pea haulm. It consists of the bolls from which linseed has been threshed out, and if, as seems likely, the growth of linseed in England spreads, considerable quantities of flax chaff will be available. There seems to be no information as to its digestibility, and no record of its practical use can be traced. Any information on this subject would be welcomed.

We have also received for analysis and comment samples of oat and wheat straw chaff which had been allowed to ferment by admixture with pulped roots. The composition of the original chaff and of the chaff after fermentation is shown by the following analysis:—

	<i>Original Chaff.</i>		<i>Chaff after Fermentation.</i>	
	<i>Per cent.</i>		<i>Per cent.</i>	
Water	..	15.0	..	16.4
Protein	..	3.8	..	3.6
Fat	..	2.3	..	3.4
Carbohydrate	..	40.7	..	39.0
Fibre	..	32.6	..	32.4
Ash	..	5.6	..	5.7

The fermentation appears to have destroyed a little carbohydrate and protein. Some of the carbohydrate has apparently been converted into fatty acids as shown by the slight increase in the percentage of fat. There seems to have been no change in the percentage of fibre. Fermentation appears to have developed an appetising smell which would probably increase the palatability of the chaff, but the figures do not indicate that it has increased the nutritive value. It is proposed, however, to carry out a digestibility determination in order to throw further light on this point.

The practice of fermenting chaff in this way is not by any means new. It was employed by the late Mr. Samuel Jonas, and is described in the *Journal of the Royal Agricultural Society of England* for 1871. Mr. Jonas at first used chaffed green-stuff, such as clover, grass, vetches or trifolium, to set up the

fermentation, but subsequently pulped mangolds were used instead. Many other variations of the process have also been used, and are described in the issue of the same *Journal* for 1892. The present samples came from Herefordshire, where the practice is apparently common. The procedure is to trample down the chaff, and scatter over the surface first a thin layer of pulped roots, then a second layer of chaff again trampled down firm, and then another layer of pulped roots. After two or three layers have been placed in the barn in this way, the remaining space is filled with chaff, which is firmly trodden down. Fermentation begins at the bottom around the roots, and spreads upwards. The method at any rate effects a great saving of space in the storing of chaff.

Since last month the fall in prices has continued, especially in the case of cakes. Palm kernel, coconut and ground nut cakes are now reasonably cheap. The prices of feeding stuffs are now recorded in the weekly reports of market prices issued by the Ministry. From these prices the following costs per food unit have been calculated:—

TABLE I.—*Costs per Food Unit.*

	s. d.		s. d.
Brewers' grains (wet)	1 8½	—	1 9½
Palm kernel cake	1 11½	—	2 3
Coconut cake ..	2 7	—	2 8
Ground nut cake, decorticated	2 8½	—	2 9½
" " " undecorticated	2 11		
Wheat sharps ..	2 11½		
Wheat middlings ..	2 11½	—	3 3
Distillers' grains (dried)	3 3		
Decorticated cotton cake	3 3½	—	3 8
Malt culms	3 4	—	3 7
Wheat bran	3 9	—	4 1
Cotton cake, Egyptian	3 9	—	4 3
" " English	3 10	—	4 7
Rice meal	3 11		
Beans, Chinese ..	3 11½	—	
Linseed cake, Indian	4 1	—	4 3
Brewers' grains (dried)	4 1	—	4 5
Maize, Argentine ..	4 3	—	4 4
Linseed cake, English	4 3½		
Beans, English ..	4 4	—	5 3
Maize meal	4 9½	—	5 0
" " American ..	4 11½	—	5 0
Barley, feeding ..	5 0	—	5 8
Oats, Argentine ..	5 0	—	5 4
" " English ..	5 4	—	6 2
Peas, English maple	5 6	—	5 7½
Indian	5 9		

The cheapest feeding stuff on the market at the present time is fresh brewers' grains. Unfortunately, from its perishable nature, its use is very circumscribed. Of the dry feeds palm kernel cake is the best value for money, its price being in the neighbourhood of 2s. per food unit. Coconut cake, ground

nut cake (both decorticated and undecorticated) and wheat sharps are all under 3s. per food unit. These make a good choice, from which rations suitable for most purposes can be compounded. Ground nut cake is a concentrated highly nitrogenous feeding stuff, containing also a fair proportion of oil. Palm kernel and coconut cakes are also concentrated foods less rich in protein and containing more carbohydrates. Wheat sharps supply a very large proportion of carbohydrates, mostly starch. The composition of these foods and most of the other dearer foods on the market is given in Table II., which has been revised in several details since last month.

TABLE II.—*Feeding Value of Common Feeding Stuffs.*

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Name of Feeding Stuff.	Nutritive Ratio.	Per cent. digestible.			Digestible Food Units per ton.	Starch equiv. per 100 lb.	Linseed Cake equiv. per 100 lb.
		Protein.	Fat.	Carbo- hydrates and Fibre.			
Foods Rich in both Protein and Oil or Fat.							
Ground nut cake ..	1:0.9	42.0	6.8	20.2	133	73	99
Soya bean cake ..	1:1.1	38.2	6.4	23.6	126	69	93
Decort cotton cake ..	1:1.2	34.6	9.3	19.4	120	71	95
Linseed cake, Indian	1:2.0	27.8	9.1	30.1	115	74	101
Linseed cake, English	1:2.2	25.3	8.7	33.0	111	74	100
Cotton cake, Egyptian	1:2.0	17.6	5.1	22.0	74	42	56
Cotton cake, Bombay	1:2.3	15.6	4.5	23.3	69	40	54
Distillers' grains ..	1:2.9	19.6	10.8	30.1	99	57	77
Mauze gluten feed ..	1:3.1	20.0	2.7	51.8	104	76	102
Brewers' grains, dried	1:3.8	13.0	5.6	34.9	77	48	65
Coconut cake ..	1:4.0	16.2	9.6	41.4	100	79	107
Palm kernel cake ..	1:3.7	17.1	6.8	43.6	98	75	101
Linseed ..	1:5.5	19.4	34.7	20.1	144	119	161
Bombay cotton seed ...	1:6.2	12.3	16.8	30.2	97	74	100
Fairly Rich in Protein, Rich in Oil.							
Mauze germ meal ..	1:7.6	0.4	12.8	48.3	102	85	115
Rice meal ..	1:10.2	7.5	11.6	40.6	84	72	97
Rich in Protein, Poor in Oil.							
Fish meal ..	1:0.2	50.0	4.2	—	125	53	71
Peas, Calcutta white ..	1:2.1	23.3	1.1	45.9	97	70	94
Beans, English ..	1:2.6	20.1	1.2	48.2	97	66	89
Beans, Chinese ..	1:2.6	19.6	1.7	47.9	101	67	91
Peas, English maple	1:3.2	19.4	1.0	52.4	99	69	93
Palm-nut meal (ex- tracted) ..	1:3.5	17.1	1.9	51.5	95	71	96
Brewers' grains, wet ..	1:3.3	5.5	2.4	11.5	30	18	25
Malt culms ..	1:3.9	19.9	1.5	43.6	88	43	59
Cereals, Rich in Starch, not Rich in Protein or Oil.							
Barley, feeding ..	1:11.4	6.5	1.8	64.7	82	71	96
Oats, English ..	1:7.9	8.0	4.0	47.4	75	59	80
Oats, Argentine ..	1:7.9	8.0	4.0	47.4	75	59	80
Maise, American ..	1:11.5	7.1	4.5	65.8	92	81	110
Maise, Argentine ..	1:11.3	7.1	4.5	65.8	92	81	110
Maise meal ..	1:14.6	5.5	3.5	64.8	85	78	103
Wheat middlings ..	1:4.6	13.2	3.0	53.8	91	72	97
Wheat sharps ..	1:4.4	12.8	4.3	50.5	92	64	88
Wheat pollards ..	1:5.2	12.6	4.0	51.6	87	60	81
Wheat bran ..	1:4.8	10.6	8.8	40.8	72	45	62
Wheat bran, broad ..	1:4.5	20.6	8.8	40.8	72	45	61
Locust bean meal ..	1:22.1	4.0	0.7	69.2	80	71	96

IN the issue of this *Journal* for last month (p. 1236), the import trade of this country in regard to food products was briefly reviewed. The improved situation in the feeding stuffs and fertilisers market is also a matter of direct concern to the British farmer, and the figures for 1919 have a particular interest as showing the very substantial recovery which has been made. Imports show an increase in the case of every feeding stuff, and every fertiliser except phosphate of lime and rock phosphate, while exports of fertilisers increased to the extent of 155 per cent. compared with 1918.

Feeding Stuffs.—The improvement in the feeding stuffs situation is well borne out by the figures in the following table:—

Imports of Feeding Stuffs.

Description.	Quantity.			Value.		
	1919.	1918.	1913.	1919.	1918.	1913.
Cotton seed tons	461,598	337,490	615,332	9,773,600	6,469,762	4,648,617
Flax seed or linseed .. qr.	2,764,559	1,309,631	3,274,062	20,662,835	8,138,170	7,193,390
Rape seed .. "	397,363	292,442	265,560	2,707,832	1,662,008	551,725
Soya beans .. tons	61,565	—	76,432	1,640,639	—	635,747
Nuts and Kernels for expressing oil .. "	499,856	443,411	81,120	19,411,392	12,696,553	1,933,052
Oil seed cake cwt.	278,274	10,828	406,700	5,821,358	210,034	2,539,892

Cotton seed came principally from Egypt, linseed from British East Indies and the Argentine, and rape seed from British East India.

Fertilisers.—Besides her imports the United Kingdom carried on before the War an export trade which in 1913 totalled over 700,000 tons, and £5,745,000 in value. The War, as might be expected, caused a reduction in the quantity exported, which diminished in 1918 to 60,089 tons. An increase to 153,064 tons, has, however, taken place during 1919. In regard to imports, there is an increase in the quantity of all fertilisers imported except phosphate of lime and rock phosphate. The quantities and values imported and exported during 1919, 1918, and 1913 are given in the two tables hereunder:—

Imports of Manures for Home Consumption.

Description.	Quantity.			Value.		
	1919.	1918.	1913.	1919.	1918.	1913.
	tons.	tons.	tons.	£	£	£
Basic slag	1,697	—	51,133	10,640	—	102,114
Bones, burnt and unburnt	13,023	5,144	40,685	177,304	221,082	219,637
Guanco	101	—	24,348	1,250	—	149,189
Nitrate of soda	24,485	300	140,926	514,528	6,000	1,490,869
Phosphate of lime and rock phosphate	351,817	464,872	339,026	1,325,511	1,948,543	874,266

Exports of Manures Manufactured in the United Kingdom.

Description.	Quantity.			Value.		
	1919.	1918.	1913.	1919.	1918.	1913.
	tons.	tons.	tons.	£	£	£
Sulphate of ammonia ..	94,435	19,150	323,034	2,267,474	480,744	4,390,547
Superphosphates ..	4,026	2,547	63,480	38,581	16,481	2 66,314
Basic slag ..	13,699	1,065	165,100	54,802	3,638	261,972
Others ..	40,904	37,327	152,437	574,160	420,216	926,656

The Need of Increased Production.—In view of the shortage of potatoes it is earnestly to be hoped that a greater area will be planted this year than was the case in 1919. Potatoes, doubtless, are an expensive crop to grow. They play, however, such an important rôle on the farm and in the national economy that it behoves all with facilities for the purpose to produce at least their own requirements. In addition, they should endeavour to raise sufficient to meet the needs of those whose circumstances compel them to look to the market for their supplies.

At the present time, when much of the land has become impoverished and foul as a result of war-time cropping, the potato crop offers both a means of cleaning the land effectively and of restoring its fertility. Even some of the heavier lands, not generally regarded as suitable for potatoes, work fairly freely, while the residues from the old grass turf remain.

It is, further, a point worth considering whether even a small crop, combined with all the advantages and effects of a fallow, is not more profitable than allowing the land to be bare for the purposes of cleaning.

The main essentials for success in potato growing are :—

- (1) the use of good "seed," preferably not more than "once grown," from Scotland;
- (2) adequate manuring;
- (3) early planting.

1. As regards "seed," varieties immune from Wart Disease should be largely planted even in districts where this disease has not appeared. The results of numerous experiments show that from the list of immune varieties a selection may be made of kinds to suit both the grower and the consumer.

2. Potatoes repay liberal manuring. An average dressing is 10 to 15 tons of dung, 1 to 1½ cwt. of sulphate of ammonia,

3 to 4 cwt. of superphosphate and 1 cwt. of sulphate of potash or its equivalent per acre. Where no dung is available the quantities of artificial manures should be increased to 2 cwt. of sulphate of ammonia, 6 cwt. of superphosphate and 2 cwt. of sulphate or muriate of potash. Manures should not be used in greater quantities than those included unless it is known to be profitable to do so.

3. With regard to planting, it is important that the first sprouts should suffer no damage. This can be obviated by boxing and careful handling; but if boxing is impracticable the aim should be to let the plants form their first sprouts in the soil. In early planting there is practically no danger from frost. As long as the soil is cold the tubers make less progress than they would do in boxes, and on light or lumpy soils in a dry climate early planting largely obviates the risk of drought.

Leaf Curl of Potatoes.—Although from 10 to 14 tons of potatoes per acre is no uncommon crop in various parts of the country, the average return is only six. To some extent this wide variation is due to climatic and manurial influences, but in many cases light crops are due to the use of inferior seed.

For the grower who makes use of obviously diseased and blemished seed there is no excuse, but it is unfortunately impossible to detect seed affected by the disease known as "Potato Curl Leaf," one of the "deterioration" potato diseases which can seriously reduce the crop. This complaint is more common in the drier and warmer parts of the country and is specially prevalent where mature seed, obtained from fully-ripened plants, is used.

As the disease is hereditary, it is of the utmost importance to avoid sowing seed from dwarfed plants or even from healthy-looking plants in plots or fields in which the potato leaf curl is common.

Where immature potatoes are used for seed each year, the disease is very rare. Growers will find that the planting of good seed potatoes, obtained from the more northerly parts of the country, will constitute the best insurance against the occurrence of Leaf Curl in their crops.

Further information regarding Potato Leaf Curl is given in the Ministry's Leaflet No. 164.

The Wheat Bulb Fly and Nitrate of Soda.—There is some evidence that dressings of nitrate of soda are helpful to wheat crops attacked by the Wheat Bulb Fly

Notes on Manures (*Hylemyia coarctata*) provided that the for May: injury has not gone too far. The nitrate

From the Rothamsted Experimental Station. helps by enabling the plant to send out new shoots and thus to keep going until the danger of the attack is passed.

Manuring for Potatoes and Root Crops.—Many experiments have shown that a good dressing for potatoes grown in the ordinary way is 10 to 15 tons of dung supplemented by 1 cwt. sulphate of ammonia, 4 cwt. superphosphate, 1 cwt. sulphate or muriate of potash. Where, however, there is reason to anticipate a yield of more than 7 or 8 tons of potatoes per acre the quantities of fertilisers should be considerably increased—the superphosphate up to 7 cwt. per acre, and the potash up to 2 or even $2\frac{1}{2}$ cwt. per acre. Increases in ammonia, however, must be carefully considered; if the dung is rich and made with cake, probably $1\frac{1}{2}$ cwt. sulphate of ammonia is as much as can safely be given. In most cases, however, owing to a shortage of cake the dung is likely to be poorer than usual, in which case sulphate of ammonia can be increased up to $2\frac{1}{2}$ cwt. per acre.

In Cheshire steamed bone flour proved better than superphosphate, and where it can be obtained at about £14 per ton it makes an economical fertiliser for potatoes; it can be applied at the rate of 5 cwt. per acre.

The potato crop seems to need phosphates particularly on the Fen soils and in the West, where the rainfall is high and the soils rich in organic matter. In the Eastern Counties, however, on sands and silts containing small quantities of organic matter, it is doubtful whether heavy dressings of phosphates are necessary; probably no more than 4 cwt. would ever be needed. Where potash can be obtained at anything from 8s. to 10s. per unit it should be used for potatoes this season, owing to the fact that the soils have become somewhat depleted of potash during the War. Several potash salts are now available; the muriate at £22 per ton (50 per cent. of potash) costs 8s. 9d. per unit, whereas £24 per ton for sulphate (48 per cent. of potash) corresponds to 10s. per unit.

Where potash is unobtainable the omission may not be serious in cool, moist districts; nevertheless, anyone who wishes to make sure of his potato crop will be well advised to use a potassic fertiliser.

Mangolds.—The mangold crop is one of the most responsive on the farm to good treatment, and is capable of giving more produce per acre than any other. Naturally this is only possible where manuring is liberally practised. A suitable dressing is :—

- Up to 20 loads of dung.
- 1 cwt. sulphate of ammonia.
- 2 to 4 cwt. superphosphate or basic slag.
- 4 cwt. kainit or 1 cwt. sulphate or muriate of potash.
- 2 to 4 cwt. salt in the drills.
- 1½ cwt. nitrate of soda as a top dressing when the plants are hoed and singled.

In moist districts basic slag may be used instead of superphosphate, but in the Midlands and southern parts of England superphosphate is the better fertiliser.

Swedes and Turnips.—The amount of manure which can be supplied to these crops depends on the yield that can reasonably be expected. In the southern parts of England it is not usual to obtain more than 12 to 15 tons of roots per acre. In such cases it is not advisable to spend too much on manure, and the most suitable dressing is 3 or 4 cwt. of superphosphate, with a little sulphate of ammonia or nitrate of soda to give the plants a good start and help them to grow away from the flea beetle. The advantage of phosphate is that a good development of root is secured and the feeding value is also enhanced. Experience all over the world shows that the quality of crops of very varied kinds is increased by the use of phosphatic fertilisers. In cases where there is the likelihood of drought in the early summer, it is desirable to use farmyard manure in order to improve the water-holding capacity of the soil. The full benefit of the manure, however, is obtained only when it has been worked into the soil during the winter so as to give it time to decompose. Professor Somerville has shown that swedes and turnips do not generally respond to combinations of farmyard manure and artificials, therefore little benefit can be expected apart from the effect on the moisture-holding capacity of the soil.

Where larger crops can be expected as in the north and west of England and in Scotland larger dressings can be given. The superphosphate can be increased to 5 or 6 cwt. per acre and the sulphate of ammonia to 1 or 1½ cwt. In place of superphosphate it is often possible to use basic slag, and nitrolim can be substituted for sulphate of ammonia. Potash is not usually needed except on peaty soils, where 1 cwt.

of muriate of potash or 4 cwt. of kainit should be given. Most farmers will use farmyard manure in addition to fertilisers for their swedes owing to the importance of securing a good tilth, but if there is any shortage it is better to reserve the dung for the potatoes and mangolds.

In cases where finger-and-toe prevails basic slag should be substituted for superphosphate; lime also should be applied, but dung should be omitted. It has been shown that the disease can be transmitted through the dung and that the organism will not flourish in well-limed soils.

Cabbages, etc.—These leafy crops require more nitrogen than almost any other crop, and in favourable situations they respond to large dressings of artificials. The mixture recommended for mangolds may be used, but the quantity of nitrate of soda may be increased according to the value of the crops, as much as 10 cwt. per acre being applied in certain extreme cases.

In the Bedfordshire experiments on light, sandy soil the highest yield of Brussels sprouts, amounting to 696 stones per acre, was given by 7 cwt. superphosphate, $1\frac{1}{2}$ cwt. sulphate of potash, and 4 cwt. nitrate of soda. On the heavier Oxford clay the potash could be omitted, but the nitrate and phosphates were still wanted.

In the Devon experiments with cabbages the best top dressings were found to be $\frac{3}{4}$ cwt. sulphate of ammonia at the time of planting, then 1 cwt. nitrate of soda applied 5 weeks later. Yields were:—

	<i>Per acre.</i>	
	<i>Tons</i>	<i>cwt.</i>
Superphosphate, kainit and salt, but no nitrogen ..	20	14 $\frac{1}{2}$
Superphosphate, kainit and salt, with $\frac{3}{4}$ cwt. sulphate of ammonia and 1 cwt. nitrate of soda	41	1 $\frac{1}{2}$

It is not unusual to give a little nitrate a few days before marketing so as to improve the colour of the crop.

Rape and other Fodder Crops to be fed off by Sheep.—Two rules are important: (1) Phosphates increase the feeding value; (2) Nitrogenous manures increase the bulk. Suitable dressings are:—

4 to 6 cwt. superphosphate or basic slag, 1 to 2 cwt. nitrate of soda or sulphate of ammonia.

POTASH FERTILISERS :

THEIR VARIETIES, COMPARATIVE VALUE, AND APPLICATION.

THE more usual potash fertilisers are Kainit, Muriate of Potash and Sulphate of Potash, together with "Potash Salts" of varying percentages, and Blast Furnace Flue Dust. All potash manures should be valued according to their content of potash (K_2O), but in the case of muriate of potash the percentage of chloride of potash (KCl) and in the case of sulphate of potash the percentage of sulphate of potash (K_2SO_4), are sometimes quoted. Invoices, however, should always state the percentage of potash (K_2O).

In order to compare the values of the different forms of potash manures, it is customary to divide the price per ton by the percentage of potash. The result is called the "unit price," which forms the best basis of comparison. On the basis of the market prices shown below, the "unit prices" will be found to work out as follows :—

—	Potash K_2O . Per cent.	Price Per Ton.	Unit Price.
Kainit	14	£ s. d. 7 0 0	s. d. 10 0
Potash Salts	30	12 15 0	8 6
*Muriate of Potash, 80 per cent. KCl =	50	20 17 6	8 4
*Sulphate of Potash, 90 per cent. K_2SO_4 =	49	23 7 6	9 6

* To reduce chloride of potash (KCl) to potash (K_2O), multiply by 94 and divide by 149. To reduce sulphate of potash (K_2SO_4) to potash, multiply by 94 and divide by 174. The reason for this rule is that it takes 149 lb. of KCl or 174 lb. of K_2SO_4 to supply 94 lb. of K_2O .

Fertilising Value.—The relative quantities of each manure to be applied will depend mainly on the percentage of potash, though there may be reasons, referred to below, for preferring one form of potash to another.

Sulphate of potash, it will be noticed, is $3\frac{1}{2}$ times as rich in potash as kainit, and, therefore, $3\frac{1}{2}$ cwt. of kainit would need to be used in place of 1 cwt. of sulphate of potash, and, conversely, where 1 cwt. of kainit is required, only 32 lb. of sulphate would be needed.

This can be expressed in tabular form. By reading the following columns downwards the amount in pounds of any one manure equal to 1 cwt. (112 lb.) of any other manure can be

seen. Sulphate and muriate of potash may, for practical purposes, be regarded as equal in potash content :—

Manure and Potash Content per cent.	Kainit (14).	Potash Salts (30).	Muriate and Sulphate of Potash (say 50).
	lb.	lb.	lb.
Kainit (14)	112	240	400
Potash Salts (30)	52	112	187
Muriate of Potash } Sulphate of Potash } (50) ..	32	67	112

SUGGESTIONS FOR APPLICATION OF POTASH TO CROPS.

Potatoes.—Shortage of potash is probably felt more severely in the case of potatoes than of any other farm crop. The light loams, the gravels and sands on which potato growing has developed so much in recent years are typically poor in potash. Growers, therefore, should endeavour to apply potash in one or other of the forms already mentioned.

**Usual Application* = 1 to 2 cwt. sulphate of potash, or 185-370 lb. 30 per cent. potash salts.

Mangolds.—Mangolds respond well to dressings of salt, and there is reason to believe that for a season or two salt can replace most of the potash usually given, especially when the normal quantities of farmyard manure are applied. The time seems now ripe, however, for testing the effect of a little potash in addition, particularly on the lighter classes of soil.

**Usual Application* = 3 to 6 cwt. kainit, or 156 to 312 lb. 30 per cent. potash salts, or 96 to 192 lb. sulphate or muriate of potash.

Turnips and other Green Crops.—

**Usual Application* = 2 to 4 cwt. kainit, or 104 to 208 lb. 30 per cent. potash salts, or 64 to 128 lb. sulphate or muriate of potash.

Cereals.—Generally speaking, potash manure is not much required by cereals. Wherever land is known to benefit from potash fertilisers—usually light land and peaty soils—a dressing may well be tried.

**Usual Application* = 2 cwt. kainit, or 104 lb. 30 per cent. potash salts.

* Where an average dressing of dung is given, the smaller quantities of the manures mentioned should be used.

Leguminous Crops.—

Usual Application = 2 to 4 cwt. kainit, or 104 to 208 lb. 30 per cent. potash salts, or 64 to 128 lb. sulphate or muriate of potash.

Grass Land.—On grass repeatedly cut for hay the quantity of potash which can be liberated in the soil is probably already very low. In such cases potash must be applied, and, if this cannot be done by feeding on the land mangolds or other food-stuffs containing potash or by applying farmyard or liquid manure, potash in some other form should be given.

**Usual Application* = 2 cwt. kainit, or 104 lb. 30 per cent. potash salts, or 64 lb. sulphate or muriate of potash.

The potash manures recommended above should be given in addition to the other manures recommended in Food Production Leaflet No. 33, except where that leaflet prescribes blast furnace flue dust, in which case the applications of kainit, etc., now recommended, are to be understood as taking the place of flue dust.

Choice of Potash Manures.—As a rule, in deciding which form of potash to use, the main determining factors should be the price per unit and the cost of transport. For potatoes and perhaps young "seeds," sulphate or muriate of potash is generally to be preferred to kainit. Other crops respond about equally well to all forms.

Purchase of Potash.—Supplies of the following grades of potash fertilisers are now, or will shortly be, available :—

Kainit	..	..	14 per cent.	K_2O	
Potash Salts	..	20	"	K_2O	
Potash Salts	..	30	"	K_2O	
Muriate of Potash	..	80	"	KCl	= 50 per cent. K_2O .
Sulphate of Potash	..	90	"	K_2SO_4	= 49 " "

For the 30 per cent. potash salts, muriate of potash and sulphate of potash, maximum prices are in force. Full particulars are contained in Leaflet No. F.P. 501/S.I, which can be obtained free of charge on application to the Ministry, 72, Victoria Street, London, S.W. 1.

Farmers who wish to purchase supplies of potash should place their orders with their usual dealer or co-operative society.

(*This article is also issued as Leaflet No. 335.*)

* Where an average dressing of dung is given, the smaller quantities of the manures mentioned should be used.

NITRATE OF LIME : ITS MANUFACTURE AND USE.

G. A. COWIE, M.A., B.Sc., A.I.C.

THE fixation of the nitrogen of the air and its conversion into a suitable chemical and mechanical form for application to the land constituted for a long time attractive problems for the chemist and the engineer alike. The actual discovery of a practical system of tapping this inexhaustible reservoir of gaseous nitrogen was, therefore, of unique importance, affording a valuable protection against a shortage of combined nitrogen for fertiliser and other purposes. In order to realise adequately the extent of this source of nitrogen it is interesting to recall that the atmosphere consists approximately of 21 per cent. of oxygen and 79 per cent. of nitrogen by volume.

In experiments described by himself in 1785, Cavendish caused the nitrogen and oxygen constituents of the air to combine by the aid of electric sparks, and in the presence of water or caustic potash obtained nitric acid or potassium nitrate. For a long time these experiments remained merely interesting class-room demonstrations, and all attempts to utilise them on a practical scale proved abortive. Research and investigation, however, were greatly stimulated by the growing realisation of the importance of nitrogen in plant nutrition and the necessity for providing fresh supplies, so as to render possible a more intensive system of food production to meet the requirements of a constantly expanding population. In 1898 Sir William Crookes depicted in rather despondent terms the grave effects of a shortage of nitrogenous fertilisers on our food supplies. His remedy for a shortage of wheat supplies was the artificial production and application to the land of much larger amounts of nitrates. While all may not agree with the conclusions of this eminent authority, his warning doubtless proved an incentive to the search for a practical method of producing nitrates from the nitrogen of the air.

The first practical success was achieved by two Norwegians, viz., Professor Birkeland of the University of Christiania, and Dr. Samuel Eyde, an engineer of Christiania, who established the now famous works at Notødden below Lake Tinnsjø. Since 1905, when the first factory was established, this industry has undergone a steady development until it has now assumed a position of enormous size and importance in Norway. During the late War there was a very considerable extension of the

industry with a view to the maximum production of various nitrogenous compounds. The output is now mainly available for fertilising purposes, principally in the form of nitrate of lime.

The process involved in the production of nitrates from the nitrogen of the air consists in passing air through an arc flame (at a temperature of about 3,200 °C.) produced between electrodes in a powerful magnetic field. The resulting nitric oxide gas is then cooled by suitable means and passed through so-called oxidation chambers, where it is given time for complete oxidation to nitrogen peroxide. Subsequently the nitrogen peroxide gas is passed up absorption towers, where it meets a descending stream of water and is converted into nitric acid. For fertilising purposes the nitric acid is then neutralised with limestone, and the product, after solidification and granulation, is sold as a manure under the name of nitrate of lime.

The commercial success of the process is dependent on the availability of cheap electric power, which, in Norway, is ensured by the numerous natural gigantic waterfalls. Full advantage has been taken of these natural resources and the huge total of 300,000 to 350,000 h.p. has now been successfully harnessed. The development of the industry in recent years has been phenomenal. In addition to some minor works there are two huge factories, one at Notodden and the other at Rjukan. The present capacity of the combined works is understood to be equal to an annual output of 186,000 tons of nitrate of lime or its equivalent per annum.

The Properties of Nitrate of Lime.—Nitrate of lime contains 13 per cent. of nitrogen, which is equivalent to 15.8 per cent. of ammonia. This nitrogen is also in the form in which plants take up their nitrogen under natural conditions, and it does not require, therefore, to undergo any change in the soil before it becomes available to the crop. In this respect it differs from sulphate of ammonia and still more from calcium cyanamide, the nitrogen in which must be transformed into nitrate in the soil before it can be absorbed by plants. In its general nature and use, therefore, nitrate of lime is closely allied to nitrate of soda.

A further important feature of nitrate of lime from the fertilising point of view is that the nitrate is combined with lime. While a part of this lime may be used for the nutriment of the crop, probably the greater proportion is left behind as carbonate of lime to improve or keep correct the physical and the chemical condition of the soil.

Nitrate of lime, as now manufactured, is of a dark grey colour and is very soluble in water. It is also hygroscopic, that is, it has the property of absorbing moisture from the atmosphere.

Nitrate of lime is now produced in a granular, dust-free condition, well adapted for sowing, either by hand or machine, without any previous crushing or treatment. Formerly, it contained a certain amount of dust which rendered the distribution, especially by hand, a more or less unpleasant operation, but this objection has been removed.

The Fertilising Value of Nitrate of Lime.—The manurial value of nitrate of lime has been adequately confirmed by the results of accurate field tests and practical evidence generally. It has proved practically equal in effectiveness to nitrate of soda on normal soils, while on soils poor in lime it has shown a distinct superiority. It has also the advantage that it does not injure the tilth of heavy soils, but will actually improve their physical condition by reason of the lime supplied. The rapid action of nitrate of lime also renders it a very effective manure when it is desired to give a crop a good start. Owing to its extreme solubility, it reaches the roots almost immediately, and its nitrogen is made directly available to the crop. Even during a drought the air moisture will gradually but completely dissolve the nitrate of lime, which will then find its way down through the soil. It therefore deserves attention as a top-dressing in districts subject to late spring and early summer droughts.

It might, of course, be reasonably argued that the ready solubility of nitrate of lime would render it liable to a certain amount of loss by leaching from the soil. The results of the comparative field trials with nitrogenous fertilisers, however, tend to disprove this idea. As a matter of fact, nitrate fertilisers are not so easily washed out of average soils as is popularly supposed, and when, as is most general, they are used as top-dressings, the risk of loss is reduced to a minimum.

The Application of Nitrate of Lime.—The production of nitrate of lime in a suitable granular form, free from dust, has removed practically all the difficulties previously associated with its distribution. It is important, however, that the material should be applied on a thoroughly dry day. If this is done, it can be handled as conveniently as can any other fertiliser.

It is also a point of practical importance that the granules should be just sufficiently small to ensure an even and efficient distribution without any previous crushing or treatment. In fact, when applied under dry weather conditions, nitrate

of lime should run very much like corn in the distributor and should fall from the hands in a more or less similar way.

Owing to its hygroscopic nature nitrate of lime is delivered in casks. The casks should not be opened until the material is required for immediate distribution under suitable dry weather conditions. It is also advisable, if the sowing is to be done by hand, to turn the sleeves well up. This avoids any unpleasantness occasioned by rubbing the skin with clothes which may have become a little damp with dissolved nitrate.

Mixing with other Manures.—Nitrate of lime, unfortunately, cannot be used in the manufacture of special or compound manures, on account of its property of absorbing moisture from the air. On the farm, however, it can be satisfactorily mixed with either superphosphate (if dry) or basic slag and, if necessary, potash salts, but in that case the mixing and that application of the mixtures should be carried out, if possible, on the same dry day.

Time of Application.—Nitrate of lime should generally be applied as a top-dressing. For root crops and potatoes, however, a proportion at least may advantageously be applied with the phosphates and potash immediately before sowing, the remainder being used as a top-dressing when the plants are above ground or after singling.

Autumn-sown Cereals.—For winter wheat and winter oats nitrate of lime should be applied about the end of March or just after the spring growth has well started.

Average dressing per acre— $1\frac{1}{2}$ to 2 cwt

Spring-sown Cereals.—Nitrate of lime for these crops may be applied as a top-dressing when the crop is an inch or two above ground.

Average dressing per acre—1 to $1\frac{1}{2}$ cwt.

Potatoes and Turnips.—For these crops perhaps the most convenient and effective plan is to mix the nitrate of lime with the phosphates and potash and distribute the mixture along the drills, or broadcast immediately before sowing. If preferred, the nitrate of lime can be applied in whole or in part as a top-dressing.

Average dressing per acre— $1\frac{1}{2}$ to 2 cwt. for potatoes, and 1 to $1\frac{1}{2}$ cwt. for turnips.

Mangolds.—For this crop it is advisable to mix about one-third of the nitrate of lime with the phosphates and potash

and distribute the mixture immediately before sowing. The remaining two-thirds can be advantageously applied as a top-dressing after singling.

If preferred, the whole may be used as a top-dressing in one or two applications after singling.

Average dressing per acre—2 to 3 cwt.

Hay.—The end of March is sufficiently early for the applications of nitrate of lime to grass land.

Average dressing per acre—1½ to 2 cwt.

Results of Field Trials.—The results of official field trials in which nitrate of lime has been compared under equal conditions with the other nitrogenous fertilisers are set out below:—

OATS (1910-1912).

Cockle Park Experimental Farm. Clay Loam.

<i>Manure.</i>	Average of 3 Trials.	
	<i>Grain per Acre.</i>	<i>Straw per Acre.</i>
	<i>Bush.</i>	<i>Cwt.</i>
No Nitrogen	40·1	22·8
Nitrate of Soda	46·5	27·0
Sulphate of Ammonia	45·3	28·8
Nitrolim	42·3	26·1
Nitrate of Lime	45·6	28·3

BARLEY (1909).

Rothamsted Experimental Station. Heavy Loam.

<i>Manure.</i>	Average of 3 Trials.	
	<i>Grain per Acre.</i>	<i>Straw per Acre.</i>
	<i>Bush.</i>	<i>Cwt.</i>
Superphosphate	28·7	23·4
„ plus Nitrate of Soda	48·1	34·6
„ „ Sulphate of		
„ „ „ Ammonia	49·0	31·4
„ „ Nitrolim	45·2	35·5
„ „ Nitrate of Lime	46·1	39·7

OATS AND BARLEY (1905-8).

North of Scotland College of Agriculture, Aberdeen.

Soils various and generally lacking in Lime.

<i>Manure.</i>	Average of 10 Oat and 3 Barley Trials.	
	<i>Grain per Acre.</i>	<i>Straw per Acre.</i>
	<i>Lb.</i>	<i>Cwt.</i>
No Manure	2,196	27½
Superphosphate and Potash	2,260	29
„ plus Nitrate of Soda	2,595	35½
„ „ Sulphate of		
„ „ „ Ammonia	2,668	35½
„ „ Nitrolim	2,847	49½
„ „ Nitrate of Lime	3,128	53½

MANGOLDS (1907-9).

University College, Reading. Strong Loam.

Manure.	Average of three years' yield of Mangolds per Acre.	
	Tons.	cwt.
No Nitrogen	28	3½
Nitrate of Soda	34	18
Sulphate of Ammonia	33	1½
Nitrolim	33	3½
Nitrate of Lime	35	1

SWEDES (1911).

Bangor College. Medium Loam.

Manure.	Yield of Roots per Acre.		
	Tons.	cwt.	lb.
Phosphate and Potash	10	15	0
" " plus Nitrate of Soda	12	0	0
" " " Sulphate of Ammonia	12	12	0
" " " Nitrolim	12	13	0
" " " Nitrate of Lime	13	1	0

"SEEDS" HAY (1914).

Midland Agricultural College. Gravelly Loam.

Manure.	Yield of Hay per Acre from two crops.		
	Tons.	cwt.	qr.
Phosphate and Potash	3	9	3
" " plus Nitrate of Soda	4	0	0
" " " Sulphate of Ammonia	3	18	2
" " " Nitrolim	3	8	1
" " " Nitrate of Lime	3	19	1

POTATOES.

Jersey Agricultural Instruction Committee. Soils Various.

Manure.	Average of 5 Trials. Yield of Potatoes per Acre.	
	Lb.	
Superphosphate and Potash	7,800	
" " plus Nitrate of Soda	8,840	
" " " Sulphate of Ammonia	9,120	
" " " Nitrolim	9,280	
" " " Nitrate of Lime	9,120	

THE COMPOSITION OF POTATOES IMMUNE FROM WART DISEASE.

E. J. RUSSELL, D.Sc., F.R.S.,

Director of the Rothamsted Experimental Station.

HITHERTO the farmer has not concerned himself much with the feeding value of the foods grown on the farm for human consumption, and a complaisant public has asked for nothing more than a natural unadulterated product. Until 1917 no attempt was made in this country to investigate the value of different varieties of potatoes as human food. Actual feeding tests on human beings had, however, been made in America. Few chemical analyses of British potatoes had been made, apart from the dry matter and the nitrogen determinations of Lawes and Gilbert in 1887. Detailed chemical analyses of potatoes are by no means easy and would not necessarily be very helpful. Physiologists regard the dry matter content as an important criterion, and ordinary conventional analytical methods indicate nothing better. Judged from this standpoint the analytical results show that absolutely unimpeachable potatoes may vary considerably in their food values, the extreme limits in the ordinary varieties on the market ranging from 17.6 to 29.1 per cent. of dry matter. It is possible that some day a different method of purchasing will prevail, and that the dry matter of the crop may be taken into consideration in assessing its market value. This would be both logical and legitimate, and if ever such a method should come to be adopted it is gratifying to know that the new immune varieties will, so far as these analyses indicate, compare favourably with the old.

During 1918 the Food Production Department arranged for determinations to be made of the amount of dry matter in different commercial varieties of potatoes grown in 1917 under different conditions in England. The results of the investigations have been published in the Report on the Composition of Potatoes grown in the United Kingdom, issued by the Food (War) Committee of the Royal Society.* Since that work was completed the Glamorgan County Council have forwarded to the Rothamsted Experimental Station samples of 32 varieties of potatoes immune from wart disease, and these have been analysed in the Rothamsted laboratories

* Obtainable from Messrs. Harrison & Son, St. Martin's Lane, London, W.C. 2, price 2s. A note on the Report was published in this *Journal*, October, 1919, p. 741.

by A. H. Bowden, who used the same methods as were adopted by Misses M. D. Glynne and V. G. Jackson in 1918; the results are, therefore, strictly comparable. The summarised results are shown in the following table:—

—	1917 Crop: Non-immune Varieties.				1919 Crop: Immune Varieties, Glamorgan.
	Mean of all analyses.		Rothamsted analyses.		
	All results.	W. country only.*	All results.	W. country only.	
Dry matter ..	Per cent. 22.09	Per cent. 21.99	Per cent. 22.41	Per cent. 21.22	Per cent. 23.93
Range of variation ..	17.60 to 29.08	—	18.33 to 26.33	18.69 to 24.76	22.11 to 27.32
Nitrogen in dry matter ..	1.48	—	1.38	1.40	1.65
Range of variation ..	—	—	.936 to 1.84	1.05 to 1.86	1.38 to 1.98
Nitrogen in fresh material ..	.327	.337	0.308	0.305	0.390
Range of variation ..	.204 to .526	—	.204 to .420	0.204 to 0.420	0.315 to 0.457
Weight of 1 tuber, Grams	—	—	139	133	152
Range of variation ..	—	—	39.25 to 203.9	39.3 to 188	110 to 202

* The four common varieties.

It is impossible to make a strict comparison between the immune and the non-immune varieties, because they were not grown in the same season. The years 1917 and 1919 differed in character, and the effect of seasonal differences is well-known and marked. In particular 1919, during the growing period of the potato, was drier and less favourable to growth than 1917, which would tend to increase the dry matter of the tubers. A general comparison only is possible, and this indicates that the percentage of dry matter and of nitrogen in varieties immune from wart disease is at least as high as in ordinary non-immune varieties, and, therefore, the consuming public will suffer nothing by the substitution of these new varieties for the old ones.

The data are too few in number to allow of any detailed comparison between the different varieties of immune potatoes. It will be observed (Table on p. 51) that the sample of Leinster Wonder stands out well with 27.3 per cent. of dry matter, while the Improved Ashleaf had 22.1 per cent. only. The percentage of nitrogen varies in the different samples, being 0.457 in the sample of Witch Hill, but 0.315 only in Lochar. These figures are chiefly of value as showing the existence of the variations: it would need many more determinations before one could say with certainty whether one variety was distinctly better than another in dry matter or nitrogen content.

* *Composition of certain Samples of Immune Varieties of Potatoes grown in Glamorganshire, 1917.*

Variety.	Dry Matter.	Nitrogen in dry Matter.	Nitrogen in fresh Tuber.	Average Weight of Tuber in Sample.
	Per cent.	Per cent.	Per cent.	Grams.
Duchess	24·63	1·628	·402	202·0
Rector	24·27	1·402	·340	201·6
Arran Victory ..	24·59	1·415	·348	146·8
Arran Rose ..	25·59	1·380	·353	167·5
Bishop	24·44	1·523	·372	158·3
White City ..	25·00	1·538	·385	191·4
Majestic	22·41	1·584	·355	176·8
Arran Comrade ..	24·31	1·610	·391	155·3
Ally	22·76	1·607	·366	165·8
Flour Ball ..	22·20	1·825	·405	129·2
Lochar	22·13	1·423	·315	163·5
Witch Hill ..	23·19	1·969	·457	131·7
Resistant Snowdrop	23·75	1·631	·387	153·7
Tinwalds' Perfection	24·35	1·657	·403	114·7
Leinster Wonder ..	27·32	1·643	·400	141·8
Kerr's New White..	26·58	1·564	·416	144·7
Dargill Early ..	21·98	1·984	·436	111·0
Provost	24·77	1·621	·401	114·8
Nithsdale	22·43	1·817	·407	202·3
Improved Ashleaf ..	22·11	1·884	·417	111·2
Burnhouse Beauty ..	24·56	1·851	·455	110·4
Kerr's Pink ..	22·92	1·632	·374	146·3
Average ..	23·92	1·65	·390	151·8

A WOMAN'S IMPRESSIONS OF A DANISH SMALL HOLDING.*

BERTHA M. BAYNE,

Late Chief Inspector, Women's Branch, Ministry of Agriculture and Fisheries.

ONE of the results of the War has been a national realisation of the importance of increased home food production, and an awakening to the need in rural England of a healthy, contented and prosperous population. The influence of women in helping to secure these desired ends is being more and more recognised, and this recognition found practical expression in the spring of last year in the appointment of a delegation of women from England and Wales by Lord Ernle (then President of the Board of Agriculture and Fisheries) to visit Denmark to study the conditions under which agriculture is carried out on the small farms in Denmark, and ascertain whether these conditions might serve as an object-lesson to prospective women small holders in this country.

Denmark is pre-eminently the home of small holders. The reason for this, very probably, may be traced to the disastrous war between Denmark and Germany in 1863-66. The Danish Government realised that if Denmark were to recover from the poverty and misery to which she had been brought through the war, salvation lay along the paths of agriculture, and, acting in the belief that agricultural production is the basis of a nation's prosperity and strength, steps were taken to parcel out the land in such a way as to bring within the reach of all who so desired the possibility of possessing their own land. To assist those desirous of settling on the land, extensive credit facilities were provided by the legislature, and co-operative methods of buying and selling were generally adopted. It is not too much to say that as a result of this wise action in the encouragement of ownership Denmark was raised from bankruptcy to prosperity, and the land was peopled with a happy and prosperous population.

The population of Denmark is now about 2,600,000, and it is instructive to note that about half the people live entirely on the land, a great proportion of the remainder being engaged in work indirectly connected with it.

* This Report was prepared by Mrs. Bayne as a result of a visit to Denmark in 1919, as one of a delegation of women who desired to study at first hand Danish conditions in relation to women's work on the land.

Of the 250,000 landed properties in Denmark, 46,600 comprise only from 12 to 35 acres, and 133,600 less than 12 acres. An interesting but surprising fact is the statement made to the delegates that practically none of these farms or small holdings was farmed or managed by women, although all the facilities granted by the Danish Government to the people have been from the beginning offered on equal terms to women as well as to men. The only cases of women small holders were found to be those where the widows of small holders had carried on the farm after the death of the husband. In reply to inquiries on this matter, the answer was that there were sufficient men in Denmark to do the farming without the aid of women, and the impression made was that at the present time the conditions and prejudices prevailing with regard to women farmers were very much the same as those which existed in this country at the commencement of the War. It is difficult to understand why this should have been so, as to work a small holding on Danish lines presented nothing that two *skilled* women (exclusive of any housework) could not advantageously undertake, without having recourse to paid labour, except at busy times.

The farms visited by the delegates were situated in the neighbourhood of Ringsted, Odense and Copenhagen, and a few of the members of the party had the opportunity of inspecting also some of the small holdings in Jutland.

The areas of these farms varied from 3 to 80 acres (the latter area constituting a large farm in Denmark), but the most usual size of those selected for inspection was from 8 to 12 acres, except in the case of Jutland, where the land was so poor that at least 30 acres are necessary in order to make a living.

The life and conditions of work of the small holder generally can, perhaps, be best understood by taking from amongst the farms visited a representative holding of 12 acres, typical of the others of a similar nature. This small holding was one of about 17 others in the district of Ringsted, and as the owner had been in America for a considerable time, it was possible to converse with him more freely and satisfactorily than could be done where one was dependent for intercourse upon the services of an interpreter. As already stated, the holding consisted of 12 acres (8½ Danish tondeland). The owner told us that he had been in occupation of it for 13 years, and that the price of the land and the cost of buildings and equipment at entry was 22,000 kroners (about £1,237*), towards which he

* Figures represent normal rate of exchange.

had contributed 13,000 kroners (about £730) at the time of purchase. It may be stated, however, that it is only necessary for a prospective holder in Denmark to provide one-tenth of the capital required for the purchase of land, buildings and equipment; the remainder will be supplied by the Danish Government at $3\frac{1}{2}$ per cent. interest per annum.

The soil of this holding was fairly light, being a medium quality loam, which, the owner said, was more or less workable at all times. His system of cropping was an eight-course one, the crops grown being rye, sugar beet, oats, lucerne, barley with seeds, mangolds, peas mixed with oats or barley, and potatoes.

As to the house and buildings, these were excellent for the purpose, as were all those we saw on the other holdings. They were built in the form of a quadrangle, and in the centre was a pump, from which the water supply was obtained. All the animals had their separate quarters under one roof, the pigs being always under cover. From the animals' quarters a drain was run to conduct all the liquid manure to a tank fitted with a pump. Farmyard manure is the main fertiliser which the holder looks to for his crops, and no portion of it is ever wasted.

The house, of bungalow type, was very nice and convenient, comfortably and well furnished. It contained a kitchen, 2 sitting rooms and 2 bedrooms, and situated over all was a large loft which could be used for storing purposes, and might, if needed, be partitioned off at one end to provide an extra bedroom.

The family consisted only of the owner, his wife, and a girl of about 10 years old, so that the small holder had to do practically the whole work of the holding himself, his wife and child assisting with the lighter work, and only at busy times. He told us that it was expensive to hire occasional labour, as the payment for a man amounted to 10 kroners a day; but that the small holders arranged between themselves that one should help the other when in need, and that this arrangement worked very well.

The live stock consisted, at the time of our visit, of 3 cows in milk (a fourth was shortly to be procured, the normal number kept on the farm being 4), 2 heifers and a bull, 2 horses, 2 pigs, and 50 head of poultry. In pre-war days, when supplies of feeding stuffs were so much more abundant, about 10 pigs were kept.

The main system of Danish agriculture is an intensive husbandry, based upon the keeping of animals and the cultivation of forage crops. There is practically no pasture on any

of the small holdings, and animals are generally tethered. We even saw this practice carried so far as to include a hen! The method of tethering prevents any waste of forage through its being trampled upon by the animals. A certain amount of extra labour, however, is entailed, as the stakes have to be moved about six times a day. It may be remarked that in the height of summer the animals appeared to be somewhat unduly exposed to the heat of the sun, and to be troubled by flies.

A co-operative dairy, bacon factory and egg-collecting depot were within easy reach of the small holdings, and practically all produce was sold there. The milk is collected by the dairy and is paid for on the basis of the amount of butter fat it contains, the skim milk being returned to the small holder for feeding purposes. The average yield of milk per cow (generally Red Danish) is from 700 to 800 gallons per annum. The pigs are taken to the bacon factory and the farmer is paid on delivery at the current market price. In addition he receives later his share of the profits based on the co-operative system, as being a member of the factory. The small holder told us that he could, in normal times, produce a pig weighing 164 lb. at 6 months old. The eggs are paid for by weight, their price being 2 kroners or about 2s. 2d. per lb. (8 eggs).

In reply to what were, perhaps, somewhat searching inquiries, yet answered in the most friendly and frank manner, the small holder said that he was very well satisfied with the life and the financial returns from the holding, although after he had provided for his family and met the working expenses of his farm, the returns were not large. (In this connection it may be of interest to mention that at a later interview with the Secretary of the Danish Small Holders' Association—himself a small holder of 17 years standing—he informed us that it was possible for a small holder on 12–15 acres to save about £50 per annum, although many of them could not save so much.) As to the strenuous nature of the life, the owner said that on the whole it was not unduly strenuous, and that he had plenty of leisure time for himself, that there were many national holidays in Denmark, and that most of the small holders were able to avail themselves of them as they came round. He expressed his position by the remark, "The place is my own, I am working for myself and I can do much or little, entirely as it suits me." He told us that he rose very early, but took a considerable time off in the middle of the day.

From the above description, which, as stated, may be taken as typical of all the small farms which we saw, it may be said that

the bulk of them are successful and that their success depends upon :—

1. Business-like co-operative methods for all buying and selling.
2. Suitable soil.
3. Convenient and good house and buildings.
4. Adequate credit facilities.

Co-operation is placed first among the causes of success, as a clear understanding of its principles by the Danish nation as a whole has enabled the country to build up on this foundation a strong and prosperous agricultural industry. This co-operative spirit is undoubtedly fostered by the small holders' schools and by the excellent rural high schools,* which are a speciality of Danish rural life.

Attention was principally directed, as is shown in this article, to the small farms, as the object of the mission was mainly to examine Danish conditions in their relation to the interests of women. It was felt that there are a great number of women in England and Wales of average ability and physical strength, with very small or no capital or income, who would welcome the opportunity of living usefully, independently and profitably in the country, and to whom the conditions of the Danish system of farming could be applied, if an adaptation to suit conditions as set forth above could be made in this country.

* See the issue of this *Journal* for last month, p. 1063.

FRENCH AGRICULTURAL SOIL MAPS.

Lieut.-Colonel LOUIS TEBBUTT has forwarded to the Ministry a sample of agricultural maps drawn up by the Agricultural Experiment Station of the Department of the Somme. The maps are placed in the Communal Town Room for inspection by all interested. The map is reproduced here to show their general character. It is really a large-scale geological map such as can be obtained from the Geological Survey of this country, but it contains in addition information as to soils derived from actual analysis.

The drawing up of these maps has long been carried out in France, the work being particularly associated with the Station Agronomique de l'Aisne at Laon. Ever since 1856 M. Risler, then Director of the Institut Agronomique, has drawn attention to the close relationship between geological origin and soil type, which in France has subsequently been strongly emphasised; writers have even claimed that soils derived from the same geological stratum have the same composition.

The colours on the map show the geological formation (Couches Géologiques). The little columns in the numbered oblongs show the chemical composition of the soil, the yellow column on the right-hand side giving the percentage of total lime (not carbonate, as would be given here*; the three left-hand columns show the number of parts per thousand (*i.e.*, percentages 'multiplied by 10) of nitrogen (slate coloured), phosphoric acid and potash. The circles with coloured sectors show the mechanical composition, the soil being subdivided into humus, chalk, sand and clay: these terms possess a definite meaning well understood by French agricultural experts, though they do not correspond exactly with the same terms as used in this country. Thus the "humus" nearly corresponds with our "Organic Matter," but is quite different from our "Soluble Humus"; the "chalk" is our "Carbonates reckoned as calcium carbonate"; the "sand" is our "Coarse Sand" and some "Fine Sand," while the "clay" is our "Clay," "fine silt," "silt," and some "fine sand."

The map is certainly very interesting and could be used effectively in discussing local experience with lime, fertilisers, etc., and the results of agricultural and horticultural trials. A village schoolmaster who was also a keen gardener could, with his local knowledge, make considerable use of it.

* Where the yellow column in the diagrams on the map is broken in the top division, the percentage of lime is higher than can be shown in the columns.

Some progress has been made in the provision of similar maps in this country, and analyses of soils which would furnish additional useful data are steadily accumulating at various centres. The problem is usually more intricate in this country than in France. The foundation of this map is the assumption that the soil arises from the formation shown on the geological map. This is not true of drift soils. France is less troubled by drift soils than we are, for over much of the Northern part of England the soil is entirely drift, and in some cases very complex drift which is not always closely subdivided on the map. There is no doubt, however, that many maps on this pattern might be made in this country, utilising material and knowledge already easily obtainable.

Lieut.-Colonel Louis Tebbutt writes as follows:—

“In the course of my duties in France as an Officer of the British Army, I visited a number of villages or ‘communes.’ The commune is a more organised and independent unit of government than an English parish, and possesses a town room or miniature town hall, which is usually attached to the elementary school.

“In one of these schools I saw a map which was covered with tracing paper to protect it from dust, light, etc. Under the tracing paper the map appeared quite different from any to be seen in England, but it resembled a geological map.

“The Secretary of the commune, who is also the local schoolmaster, explained that it was an agricultural map of the parish. He could not say more, however, as he had only lately come into the parish, but I was informed that this map had been made at the ‘Station Agronomique,’ which is or was at the chief town of the Department.

“I therefore visited the ‘Station Agronomique,’ where I made the acquaintance of the Chief or Director, who had made this map and other similar ones. The ‘Station Agronomique’ is a semi-state laboratory, and the Director is a person who has made a special study of geology, agriculture, chemistry, surveying and foodstuffs. His qualifications are similar to those of an English public analyst, but he possesses a special knowledge of the scientific side of agriculture.

“A large library of books, pamphlets and magazines was attached to his office, besides his laboratory, and in the course of his duties he analysed soils, milk, manure, etc., and gave advice. He said that he could not advise the agriculturist on practical farming questions, but he could assist him on the scientific side of his business.

" With the geniality and intelligence of a French professional gentleman, he explained how these maps were made, and was willing to copy one with the preliminary sketched plans.

" His laboratory staff was then reduced in number, and he was at work helping in the devastated areas of the North of France, but with considerable trouble he had the map (reproduced here) copied.

" The genesis of the maps is in the Communal Council, when it decides to ask the General Council of the Department (a similar body to the English County Council) for a grant to arrange a survey. The General Council will grant a part of the cost on condition that a copy of the survey is sent to them, and I think the State also is asked to contribute. When the decision to draw up a map is made, the Chief or the Director of the Station visits the parish, and prepares a copy of the cadastral map of the area to be surveyed.

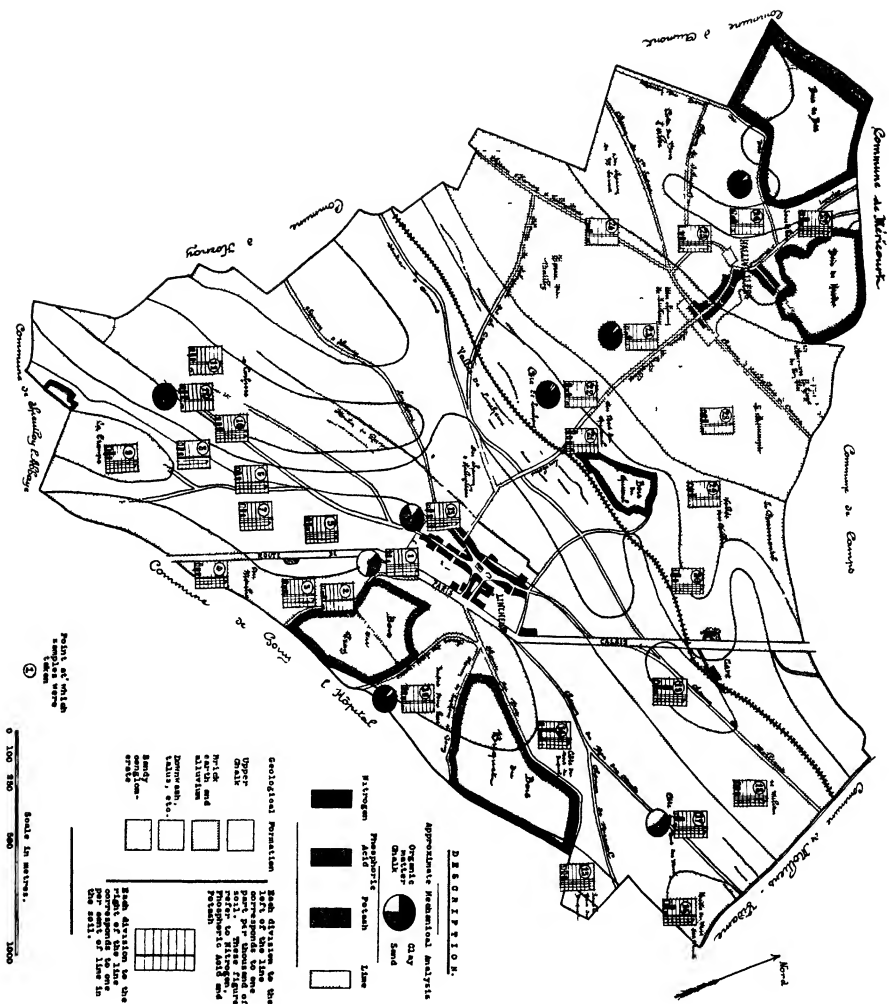
" After correcting the cadastral map the Director next obtains the geological map made by the State and corrects it by going over the parish himself and making a geological drift survey. The next stage is to draw samples of soil of each part, taking great care properly to arrange the samples. Each sample is put in a special bag, numbered and marked, indicating the place from which it was drawn. These samples are taken to the Director's laboratory and are analysed chemically and physically.

" In the map copied, 30 samples were made. All were analysed for chemical composition and eight were analysed physically. On each place from which a sample was taken a small diagram is drawn, showing the percentage of nitrogen, phosphoric acid, potash and lime. The eight physical analyses are shown also on the map,* as well as diagrammatically. The name of the Station and the kind of soil are shown by colours and letters.

" With the map a monograph is prepared, giving information as to the history of the agriculture of the parish—the areas devoted to the various crops, and census of animals. The monograph is a small book of 11 pages.

" The next and last stage is a meeting of the agriculturists of the parish, in order that the Director may explain the map and the various uses to which it may be put, as well as the relative values of the manures applicable to the soils in the parish. The kinds of wheat and corn used may also be discussed.

* Nos. 1, 12, 13, 17, 22, 23, 26, and 30.



"The agricultural survey in respect of this map was made in 1911, by Monsieur L. Crochetelle, Director de la State de la Somme, Amiens.

"The bridging of the gap between science and practice is one of the great needs of British industry and commerce, especially with regard to agriculture, and the employment of these agricultural maps should help in this direction. Science combined with practical knowledge is the surest road to financial success. As regards the expenses of this survey, the whole cost was less than £50, and this would probably be more than repaid by results in the first year."

WILD white clover is indigenous on grass lands throughout the country, being found both on the best fattening pastures and frequently on quite poor types of grass land. If present on a field even in minute quantities it responds freely to basic slag and rapidly increases in amount under the influence of this manure.

**Wild White Clover :
Its Value in
the Formation of
Pastures.**

The great value of wild white clover in the formation of pastures is due largely to the rapidity with which it forms a sward, and thus keeps out weeds ; and to its beneficial effect on the grasses associated with it and on the fertility of the land for subsequent arable crops when the turf is broken and the residues are ploughed down. Seed of wild white clover should be included in all mixtures for leys of three or more years' duration ; it hastens the development of a close sole, encourages rough-stalked meadow grass—a nutritious plant which remains green throughout the winter—keeps out weeds, and makes for fertility.

Some striking results of experiments comparing ordinary white Dutch clover with wild white clover are reported from the North Wales University College. Trials with seed mixtures were carried out at five centres, and 2 lb. of wild white clover in the mixture was compared with 2 lb. of ordinary white Dutch clover. The proportion of ground occupied 2½ years after sowing was 23 per cent. of wild white clover, or ten times as much ground as was covered by the ordinary clover. In fact it was probable that the plants from ordinary seed had all died out after 2½ years, and the plants occurring were the product of seeds present naturally in the soil before seeding. The difference resulting from using wild white clover was still

quite marked even after 5 years. Where the land has been ploughed up a much heavier crop of oats has almost invariably resulted from the wild white clover.

At present prices of 30s. to 35s. a lb. it may not be economical to sow as much as 2 lb. per acre, but $\frac{1}{2}$ lb. per acre of wild white clover seed adds greatly to the value of a seed mixture and should, as a rule, be included for both temporary leys and permanent pastures. With proper treatment the rooting thus obtained will be sufficient to provide an ample covering.

It is highly desirable that more farmers should arrange to harvest seed supplies of this valuable plant. For immediate requirements, fields which are naturally full of white clover should be selected. The crop should not be cut until it is ripe. In most cases the ordinary hay mowing machine, with the knives set as low as possible, will be found quite satisfactory, but when the crop is very short it may be necessary to cut with the scythe.

Information as to handling the crop after cutting will be found in a bulletin issued by the Ministry on Growing Wild White Clover for Seed. Threshed and roughly dressed by such means as are at the disposal of the farmer, the seed may be used for his own purposes. Any surplus could readily be disposed of to seed merchants who have special machinery for cleaning and dressing before the seed is offered for general sale.

Where it is desired to establish white clover meadows for seeding purposes, old pastures with little grass (but with a sprinkling of white clover) are usually selected. They should be dressed with about 7 to 10 cwt. per acre of basic slag in the autumn or early winter and should be grazed with cattle till the end of May in order to keep down the grass. The clover should then be fit for harvesting in August or September.

THE ESTABLISHMENT OF VILLAGE INDUSTRIES.

SIR JOHN L. GREEN,

Director of Rural Industries.

IN considering the matter of village industries County Councils should have regard to the question whether the results of any action on their part will directly or indirectly improve the conditions of the agricultural industry and of those dependent upon it.

It is highly undesirable to draw away those now engaged in purely agricultural work, bringing in due economic reward, in order that they may engage in other forms of work not so directly connected or, perhaps, not even connected at all, with agriculture. The real object should be to seek to improve the conditions affecting the agricultural industry, and any avenue leading directly or indirectly to that should at least be explored.

Within these limits there can, in the writer's opinion, be no doubt that there is a wide field for useful effort on the part of County Councils, though the effective and permanent results of such effort will naturally be more pronounced in some counties than in others.

County Councils should first ascertain what is reasonably possible or practicable, for instance, what rural industries—apart from agriculture itself—really exist in the various parishes, what their condition is, and whether they are capable of improvement, and, if so, to what extent and in what way can that improvement be brought about? They should further inquire what other industries can be started, and the extent to which they can be fostered, and by what methods.

It will probably be found that local conditions will in many cases determine what it is possible to achieve. For example, where osiers are available, where forestry is encouraged, or where an "underwood" industry exists, there should be room for the improved or increased production of baskets (both of the fancy and utilitarian types), hurdles, spars, wooden toys, etc. These represent industries which would appear to offer great scope for development, since, in the main, they can be performed when purely agricultural operations are slackest.

There is no very great skill required in making baskets, and these could be made under healthier conditions in the country or country town than in a populous urban centre, while the

actual sales of country-made baskets could, it is asserted, be as well and as economically transacted as under existing conditions in the towns.

Further, inquiry has shown that here and there throughout the rural districts, and especially in the smaller market towns, there are usually one or two basket-makers who, not altogether through their own fault, live a more or less precarious existence, but who, if they and their industry were taken in hand, could be helped with advantage both to agriculture and to the general public. At present these workers appear usually to make one or two kinds of baskets which they sell generally to the farmers and other villagers of their respective districts, either by calling upon them for the purpose or by exposing their wares for sale in the market place or in a shop in the market town.

The industry and, therefore, the livelihood of the basket-makers is precarious; but the reason for this unsatisfactory state of things is largely that the men themselves show a lack of enterprise in making only a very small range of goods, while their usual method of selling is wasteful in the extreme.

The best remedy is the production and co-operative disposal of a larger range of marketable commodities. As regards production, the education of the basket-makers is of importance, for if a greater range of baskets is to be produced the makers must be provided with the necessary tuition. It should not be difficult to give this to men who already have skill. Further, the co-operative movement should include not only the disposal of goods but also the continuous supply of fresh designs.

Another medium for the encouragement of village industries has been the Women's Institutes movement, the progress of which during the past five years has been phenomenal. The potentialities of that movement are far from being fully appreciated.

During the early years of the War women in many English counties started the making of all sorts of stuffed toys, fancy leather goods, and other small articles. The work was closed down at the end of 1917, owing to the desire of the Government to employ the people engaged in it in more useful occupations directly bearing on the conduct of the War. By that time, however, it had been proved that our country people possessed the necessary talent to produce goods equal in quality to the competing imported articles, if only they were given the opportunity to display their ability. That opportunity had been given; the goods the villagers produced were readily

sold in 200 to 300 retail shops from Newcastle-on-Tyne to Plymouth, and also exported (*e.g.*, to America and Denmark), money going regularly into the pockets of a considerable number of country workers.

Under good business management, the Women's Institutes are eminently fitted to revive and carry on this work. It must be remembered that the occupations are such as do not necessarily demand constant application, and that, therefore, they appeal very strongly to the mothers and daughters who can often employ an odd hour or two daily, or a few hours weekly, on such occupations, with pleasure and profit to themselves, but who could not give regularly so much as three, four, five or more hours a day.

When considering the utility of "domestic industries" it should also be remembered that if pleasurable and profitable home work can be given to the grown-up daughters of a family there is less likelihood of the girls leaving home for the urban centres.

This work, too, appeals not only to the cottage women and to their daughters but also to a considerable number of women of education and reduced incomes, whose education should be of great value in a movement of this sort, and who are, in fact, its natural leaders wherever they can be found. There is every reason why educated women should join forces with the cottage women, under careful and energetic management, and to make rural employment of economic advantage to themselves and to the nation.

If these and other rural domestic industries are to be as successful as they might be, and ought to be, it is necessary that County Councils should provide instruction in them. It is also necessary that, in addition to instruction, provision should be made for supplying a succession of the most attractive designs to learners and workers so that the public may constantly see new articles coming on the market.

If these two matters receive attention, and if, also, raw materials are purchased, and the goods made from them are sold under a system of co-operation or some other organised method, success should be assured.

PRESERVING GREEN FODDER:

AN INEXPENSIVE TRENCH SILO.

A. W. OLDERSHAW, M.B.E., B.Sc.,

County Agricultural Organiser for East Suffolk.

ENSILAGE is at the present time receiving much attention from farmers in all parts of the country, partly no doubt owing to the introduction of cylindrical stave and concrete silos of the American pattern. Unfortunately, however, the process has been heavily handicapped during the past three years by the high cost of these structures. Mr. Arthur Amos, M.A.,* recently estimated the cost of a cylindrical silo capable of holding 150 tons of silage at £400. Where suitable materials for making concrete exist on the farm the cost of erecting a silo might conceivably be less, but in any case it is bound to be high. The large initial outlay involved will cause even large farmers to hesitate, while to small farmers the cost will be prohibitive. The writer has given a brief account of these cylindrical silos elsewhere.†

In these circumstances any alternative method of making silage is worth considering, even although the method may be less perfect, and may involve rather greater loss of material than would the cylindrical silo.

The writer has elsewhere‡ referred to a method of making silage which has been practised by Mr. Wm. Makens, of Colney, Norwich, for a number of years. The method was described in some detail in the issue of this *Journal* for July, 1919, and photographs were given showing the "trench" when full of silage, and also the operation of covering with earth. The trenches used by Mr. Makens vary in size; the largest is 4 ft. deep, 25 yd. long, and about 5 yd. wide. This trench is filled with green material and afterwards covered with earth. In the year 1919, owing to drought, the quantity of green material available to fill Mr. Makens' trenches was very small. The material used was rye and tares mixed, and for some reason the tares made a comparatively small growth, with the result that the green stuff consisted largely of rye. The quality of the silage, however, proved satisfactory.

* Paper read before the Farmers' Club, 1st March, 1920.

† Transactions of the Highland and Agricultural Society of Scotland, 1917, and this *Journal*, February, 1917, p. 1063.

‡ Journal of the Bath and West and Southern Counties Society, 1918-19, and this *Journal*, July, 1919, p. 450.

The writer had an opportunity of gaining further experience of this method of making silage, when visiting his father's farm in Nottinghamshire during the summer of 1919. A field of second-crop clover and rye-grass, consisting chiefly of clover, was available. The weather had for some time been very showery, the dews in the morning were very heavy, and considerable difficulty was anticipated in making the crop into satisfactory hay, especially as it was very succulent. It was, therefore, decided to make it into silage. In Mr. Makens' case the land is very light, and all drainage from the silage, with any rain water, easily passes into the subsoil, from the bottom of the pit. In this case, however, the land is heavy, and at the most convenient site where the silage could be made no simple method existed whereby underground water which might accumulate at the bottom of a deep pit could be drained away by pipes or other means. There was, further, no deep ditch near. It was, therefore, decided not to excavate so deep a pit as was used by Mr. Makens. The site chosen, a piece of ground about 10 yd. long by $3\frac{1}{2}$ yd. wide, was ploughed over, and the soil then thrown on to the side by hand. This process was repeated in the case of the subsoil and was continued until a depth of about 2 ft. 6 in. below the surface was reached, when the floor was levelled by hand.

The subsoil at this depth was rather unexpectedly found to be much lighter and more pervious than the surface soil, and might be described as a loam rather than a clay. This possibly explains why no trouble was experienced from standing water accumulating in the pit, as might have been expected from the texture of the surface soil.

As soon as the pit was excavated a portion of the crop was cut, and men and women were engaged in carting home the crop. The operation is very similar in every way to the carting home of mangolds. A boy was employed on the carts, and three women and one man performed the work of filling them. On reaching home the carts were merely tipped into the trench, and the long green clover was roughly levelled. To compress the material the full and empty carts were drawn over the mass in the trench, and as the work progressed a horse was employed to walk about on the green mass in order to consolidate it. In most cases it was found possible to send the carts back empty within five minutes of their arrival full of clover at the trench. All the work of emptying the carts and levelling the green material was performed by one man until about the last day of filling. The work was continued for four working days in



Removing Clover and Rye grass Silage from a ' trench ' silo on Mr. John Oldershaw's
farm

all, but the days were not consecutive. The work commenced on a Monday, was continued on Tuesday and was then resumed on Friday and again on the following Monday. This gave time for the mass to settle somewhat before the final filling. A seven-acre crop of clover was put into the trench, and the heap was then topped up as well as possible with green clover and finally with rough stuff from hedge bottoms. Afterwards, as soon as the operation could be carried out, it was covered with earth, when it resembled a mangold pit. It may be mentioned that the heap was made as high as it conveniently could be by carting full loads up the ends, being subsequently topped up by hand.

The material was put in on the day of cutting, and owing to heavy dews was often very moist in the early part of the day. This pit was opened about Christmas, and a sample was taken for analysis. It was found that the rainwater had penetrated to a depth of two or three inches, causing the material to rot to that depth, while a certain amount of the silage on the sides and ends had also become rotten. Apart from this the bulk of the silage proved of excellent quality, and was relished by the stock, which left good hay to eat it as soon as they became accustomed to it. Being in its long state it was cut out in sections exactly as is done with hay, and carted to the stock. It was used regularly during January and February, being fed mainly to milk cows and store cattle. The quantity fed was one cart-load a day, and the heap lasted for 69 days.

It is very difficult to estimate the proportion of waste on the sides and top of the heap, in fact this could only be done by weighing every cart-load of good and spoiled material taken out of the silo. There was practically no spoiled material on the bottom, although the green clover was placed directly upon the bare earth. The only serious amount of waste was on the top of the heap; this was thought to be caused by the rainwater soaking through the earth covering. This could be prevented by roughly thatching the heap with straw "battens" or straight bundles on the top of the earth covering. It appears best roughly to thatch on the outside of the earth rather than inside, as the main object of the earth is to keep out the air, and if the thatch were placed inside the earth a layer of air would come in contact with the silage.

This method of making silage, although admittedly less perfect than the cylindrical silo method, has the great advantage that no heavy initial expenditure on buildings or on chaffing and blowing machinery is involved. It appears eminently

suitable for small farmers and small holders, and its use may easily prevent the loss of succulent material such as a second crop of clover, second or third crop lucerne, and similar crops which are available at a time of the year when, especially in the Midlands and North of England, it is difficult to make good hay owing to heavy dews and short days.

The following analyses were kindly made by Mr. G. S. Robertson, M.Sc., of Chelmsford. It will be noticed that the percentage of moisture in the clover and rye-grass silage is high, owing undoubtedly to the moist state of the crop when placed in the trench.

		<i>Tares and Rye</i> (chiefly Rye). (Mr. W. Makens).	<i>Clover and Rye-grass</i> (chiefly Clover). (Mr. John Oldershaw).
Moisture	..	64.26	81.41
Oil	.. ..	1.59	1.05
Albuminoids	.. ..	3.87	3.40
Carbohydrates	.. ..	13.79	5.28
Fibre..	.. ..	14.30	6.46
Ash	.. ..	2.19	2.40

The accompanying photographs show the operation of removing the silage from the trench on Mr. John Oldershaw's farm.

AIR POLLUTION BY COAL SMOKE.

ARTHUR G. RUSTON, B.A., B.Sc. (Lond.), M.Sc. (Leeds),
*Lecturer in Farm Economics, Department of Agriculture, The University,
 Leeds.*

AMONG the many subjects that in recent years have engaged the attention of those interested in the improvement of the public health of our city communities, the question of atmospheric pollution has obtained a place which is slowly gaining in importance. The subject is commonly discussed, however, as if the pollution were rigidly confined within the municipal boundaries, and solely of importance in its bearing upon the health of the ratepayer and the appearance and durability of his property. In view, however, of the undoubted damage done by smoke pollution to vegetation in general and to garden crops in particular, the question has also a significance for the agriculture of the neighbouring semi-urban districts.

Comparison of Domestic and Boiler Soot.

A good coal contains a large amount of carbonaceous matter leaves a small residue of ash on burning, and has a low sulphur and arsenic content. When coal is burnt some of the carbonaceous matter escapes into the air in the gaseous form, either as carbon monoxide or carbon dioxide; some distils and comes over as tar; some goes up the chimney unconsumed and is deposited as soot. When one considers the varying conditions under which coal is burnt, it is obvious that the character and composition of soot must vary considerably. The higher temperature and stronger draught of a factory furnace produce a soot which contains more ash and less tar than is the case with the domestic grate. The soot also varies in character with the distance at which it has been deposited from the grate; another factor which will influence the character and composition of the soot will be the kind of coal used.

The following analyses illustrate these facts very clearly:—

Analyses of Soot from the University.

	<i>Domestic Soot.</i>		<i>Boiler Soot.</i>		
	<i>Per cent.</i>		<i>Base, Per cent.</i>	<i>70 ft. up, Per cent.</i>	<i>Top 110 ft. Per cent.</i>
Carbon	.. 40.50	..	16.66	21.80	27.00
Hydrogen	.. 4.37	..	0.86	1.44	1.68
Nitrogen	.. 4.09	..	0.00	1.18	1.21
Ash	.. 18.16	..	75.01	66.04	61.80
Tar	.. 25.91	..	0.09	0.80	1.66
Sulphur	.. 2.99	..	2.67	2.58	2.84
Chlorine	.. 5.19	..	0.11	1.46	1.60
Arsenic	.. —	..	0.078	—	0.12
Acidity as H ₂ SO ₄	0.37	..	1.33	0.58	0.56

The differences between the domestic and boiler soot, thus obtained from the same coal, are striking and instructive. The sample from the base of the boiler chimney is little more than dust ; practically all the hydro-carbons have been burnt, while what few have volatilised have at the temperature there prevailing no chance of recondensing. Further, the more volatile constituents, ammonium-chloride and sulphate, and arsenic, accumulate. The sample of domestic soot is typical of all those which have been analysed by reason of its high content of tar and volatile substances and its low content of ash. In some samples of domestic soot the amount of tar may even reach as high as 40 per cent.

Impurities in the Air due to Smoke.

With a view to estimating the nature and amount of the impurities in the air of an industrial town, ten representative stations were selected in Leeds, and one on the University Experimental Farm at Garforth, some $7\frac{1}{2}$ miles due east of Leeds. Of the Leeds stations some were in the heart of the industrial area, and others in various residential quarters. The impurities are partly in the form of suspended matter, consisting of soot, tar, sand and mineral matter ; and partly in solution, consisting of sulphurous and sulphuric acids or their salts, chlorides, largely in the form of hydrochloric acid or common salt, and nitrogenous matter.

The figures as to the amount of solid impurities in the air taken at the different stations showed that the impurities diminished rapidly from the industrial area northwards into an agricultural area. In the centre of the town the yearly deposit was 850 lb. to the acre ; less than a mile north the figure fell to 400 lb. ; and just over two miles to the north it fell to 150 lb., or little more than one-sixth of the deposit in the centre of the town. The investigation showed that in the chief industrial centres of Leeds the solid impurities due to smoke pollution are roughly twenty times as abundant as in the purer atmosphere some three miles north-east, in the agricultural country.

By far the most deleterious and objectionable of all the suspended impurities is the tarry matter. At all stations an appreciable amount of tar was found to be deposited, the amount being greatest in and near the industrial area and diminishing rapidly towards the north.

It is interesting, however, to note that the suspended matters in the suburban areas, though smaller in amount, are much richer in tar than those of the industrial area. There is thus

a characteristic difference between the contamination arising from the factory shaft and that attributable to the very imperfect combustion of the domestic range.

Effect on the Growth of Plants.

The solid impurities, present in the air of towns and due to pollution by coal smoke, play a very important part in detrimentally affecting the growth of plants. Their effect in diminishing the amount of sunlight in industrial towns may be gathered from the fact that, in 1907, the number of hours of bright sunshine registered in the centre of Leeds was 1,167, as compared with 1,402 at Adel, some four miles to the north. In other words, the smoke-cloud hanging over the centre of the town curtailed the duration of bright sunshine by about 17 per cent. If, however, there is measured, not the number of hours of bright sunshine, but the actual intensity of the light, it is found that not only is there a greater curtailment, but that there is a sharply defined correlation between that intensity and the known solid impurities in the air.

In Hunslet, in the centre of the industrial area, fully 40 per cent. of the light was shown to be shut off. The energy of sunlight is required by the green leaf for the conversion of carbon dioxide into carbohydrates, and when 40 per cent. of that energy is cut off by the smoke cloud, the effective growth of the plant must be very seriously checked.

Further, the greater part of the material of which the leaves of plants is composed is taken from the atmosphere. The leaves of plants possess minute pores, or stomata, by means of which they absorb carbon dioxide from the air, this carbon dioxide being converted in the plants into starches, sugars, or other carbohydrates. Soot, as has already been pointed out, is not pure carbon, but contains varying amounts, occasionally as much as 40 per cent. of a thick oil or tar, which causes the soot to adhere tenaciously to vegetation, so that it cannot easily be removed by the rain. It thus hinders the intake and assimilation of carbon dioxide necessary to the growth of the plant. The black adhesive film which thus settles on vegetation affects the leaves of trees and evergreens in particular.

In addition to blackening the vegetation the black deposit covers the whole leaf with a kind of varnish and fills up the pores or stomata, thus effectively checking the natural process of transpiration and assimilation. Evergreens suffer most in

this respect because they are also affected by the winter smoke ; of the evergreens the most susceptible, owing to their characteristic sunk stomata, are the conifers.

Effect of Acid in Soot on Growth of Plants.

The samples of soot were also nearly all found to be distinctly acid in reaction to methyl orange, thus indicating the presence of free mineral acids. The amounts of these acids thus brought down by the rain were found in the more polluted parts of Leeds to be as great as eighty pounds per acre. The deposition of acid along with soot upon the leaves of plants is probably one of the main causes of the early withering which is so characteristic of many forms of town vegetation. Ash trees in the purer parts of Leeds often retain their leaves six weeks longer than those in the more contaminated districts.

If, therefore, we regard the leaf as the factory of the plant, we find that, owing to smoke pollution, the factory is actually closed for six weeks out of the four or five months of its working year, while during the remainder of the time, as our assimilation experiments show, it will be working at less than half its normal pressure.

The presence of smoke contamination is usually made manifest by an increased sulphur content in the leaves of trees. From observations made at Leeds it appeared that in the more smoke-infested areas there is not only an increased deposit of sulphur compounds with the soot upon the surface of the leaves, but that there is also an increased intake of sulphur dioxide, which, owing to its germicidal action, tends very considerably to lower the stamina and vitality of both plants and animals.

Sulphuric Acid in Rain Water.

Sulphur dioxide, on coming in contact with air and moisture, passes rapidly into sulphuric acid. The presence of sulphuric acid in rain water has a harmful effect on the vegetation, and excessive acidity may check growth altogether. Grasses watered with water, the acidity of which was 32 parts per 100,000, were killed off in little more than three months, and not a trace of vegetation of any kind was visible in the following spring ; while water, the acidity of which was 16 parts per 100,000, proved fatal in less than a year.

It was also shown that while the final effect of acidity was to destroy vegetation altogether, smaller amounts had the effect of reducing both the quantity and the quality of the herbage. Thus, in every case a larger amount of acidity meant a decreased

yield, an increased fibre content, indicating that the grasses were indigestible, and a decreased protein content, indicating a low feeding value. The effect of the acidity in the soil itself was shown most markedly in the reduction in the number and activity of the soil bacteria, of which the most valuable and at the same time the most sensitive are the nitrifying organisms.

The results of the bacteriological investigation of the soils revealed the fact that while the activity of the "ammonia-producing" organisms was cut down by 42 per cent. by the application of the acid waters, the activity of the nitrifying organisms was cut down by more than 88 per cent.

Effect of Acidity on Soil Bacteria.

Under normal conditions, the protein present in the organic matter in the soil is seized on by the first group of bacteria, the putrefactive organisms, and it is their work to break the protein down into ammonium compounds. The ammonium compounds, however, should not accumulate. A normal soil rarely contains more than four parts per million of nitrogen in the form of ammonia. Other organisms are waiting for these ammonium compounds and convert them first of all into nitrites and finally into the finished products nitrates. While in a normal soil the ammonium compounds are converted first into nitrites and then into nitrates almost immediately, other conditions may prevail in abnormal soils. The nitrifying organisms are much more sensitive and more easily damaged than are the putrefactive organisms, and particularly are they susceptible to acid conditions. Hence, if the workers in the nitrate factory of the soil have to put up a fight against hostile acid conditions, it will be the nitrifying department which will close down first; and, if the ammonia-producing organisms are still able to go on working, this will result in an accumulation of ammonium compounds in the soil. Such or similar conditions are to be found in many of our town gardens, and on the farms in and near industrial areas. The acid rainfall is sufficient to keep in check the nitrifying organisms, though not perhaps powerful enough to prevent the more vigorous putrefactive organisms from continuing their work; and the amount of nitrogen in the form of ammonia may rise to as much as twenty parts per 100,000.

On the other hand, the acid conditions in the soil may become so unfavourable to the growth of bacteria that even the putrefactive organisms are unable to work. In this case there will remain in the soil an accumulation, not, of nitrates—the

finished product, nor of ammonium compounds—the intermediate product, but of undecomposed organic matter—the raw product. This is noticeable in the soil of one area in Leeds where, owing to the abnormal pollution of the atmosphere, even the ammonia-producing organisms are killed off. It can also be seen in the accumulation of matted roots in many old pastures, particularly in smoke-infected areas.

Effect of Acid Conditions on Grass Land.

In some fields at Garforth, beneath the actual turf lies a mat, 4 to 6 in. deep, of undecayed vegetable matter, because the soil is so acid that even the vigorous putrefactive organisms are unable to continue working.

Grass land, possessing such a layer of undecomposed peat above the soil, will suffer severely in times of drought, burning up and turning brown quickly. The peaty mat will absorb any rain which falls, to such an extent that heavy and prolonged rain is required to wet the soil below. In 1917 the county suffered a period of practical drought from the middle of April until the end of July. August, on the other hand, was a month of heavy and continuous rain; yet at the end of the month, although rain had fallen 28 days out of the 31 and the total rainfall for the month had been more than 6½ in., the soil below the peaty mat was quite dry and powdery. Many of the soils on the coal measures in the West Riding of Yorkshire are naturally deficient in lime, and, where this deficiency is accentuated by smoke pollution, they may require as much as 2 or even 3 tons of quicklime per acre to neutralise the acidity. Once this acidity is neutralised by the application of chalk or lime the putrefactive organisms can work, and the mat disappears. In November, 1911, estimates were made of the water-contents of the soil taken from two adjacent plots at Garforth. The soil from one plot, which had received a dressing of 6 tons of quicklime per acre in December, 1898, contained 22 per cent. of moisture; whereas the soil from the second plot, which had received no dressing of lime and which had a thick mat below the turf, only contained 8 per cent. of moisture.

Deficiency of Lime due to Acidity in Soil.

It has already been pointed out that the acid rains tend to neutralise the free lime present in the soil, the calcium sulphate thus produced being washed out and finding its way into the drains. This action naturally tends to leave the soils poor in "available lime." Practically none of the soils on the farm

at Garforth contains more than 0.2 per cent. of free lime ; most of them contain considerably less. If there is a deficiency of lime in the soil, it is only natural to expect a deficiency of lime in the crop growing on that soil. For bone formation, the ratio of lime (CaO) to phosphoric acid (P_2O_5) should be approximately 1 : 1. In green foods like grass, hay, turnip-tops, etc., lime is in excess ; in the cereals and concentrated foods phosphoric acid is in excess. The ratio of lime to phosphoric acid in normal meadow hay is approximately $2\frac{1}{2}$: 1 ; in normal seeds' hay the ratio is approximately $3\frac{1}{2}$: 1. Thirteen different samples of hay produced on the farm at Garforth have been analysed, and the average resulting ratio of lime to phosphoric acid in the samples has been, not 3 : 1, but 1.12 : 1. Since hay and grass are practically the only foods fed to cows where the lime present is in excess of the phosphoric acid, and since the ratio, phosphoric acid to lime, is :—

in linseed cake	..	.	4 : 1
in cotton cake	..	..	10 . 1
in coconut cake	..	..	3 : 1
in palm nut cake	..	..	4 . 1
in ground oats	..	..	7 : 1

it is to the hay and grass that the cow must look to make up the deficiency of lime in the other foods. In a normal milk the lime and phosphoric acid are usually present in approximately the same proportions as are required for bone formation, and the ratio of lime to phosphoric acid approximates to 1 : 1, and rarely falls below 1 : 1.25.

Some two or three hundred samples of milk produced on the farm at Garforth have been analysed, and all have shown a considerable deficit in lime, the average ratio of the samples analysed being not 1 : 1, but 1 : 1.54, and in some cases being nearly 1 : 2. This poorness in lime of the milk produced in our industrial areas is a matter of considerable importance.

Economic Effects of Smoke Pollution.

The economic effects of smoke pollution with its deposits of tar and acid upon the grass land in the smoke areas are enormous. The leguminous plants and finer grasses disappear and the herbage usually consists of bent, Yorkshire fog, woodrush, sorrel, yarrow and moor grasses, while the feeding value of the coarse grasses and weeds which survive is considerably reduced.

This deleterious effect on vegetation is also reflected in the diminished stock-carrying capacity of the land ; and land

which some thirty years ago was carrying two bullocks to the acre will now carry less than one head of stock to three acres.

In many cases the pollution of the air by coal smoke has resulted in an economic loss of rent. An instance may be quoted of land near one of the coal mines in the Barnsley district, where the rent which in 1887 was 52s 6d. per acre was reduced in 1890 to 27s per acre on condition that no claim was made for damage from smoke pollution. In 1900 the rent was again reduced to 20s per acre, and in 1902 further reduced to 10s. per acre. At the present time this land consists of little more than derelict grass land, or barren arable land growing practically nothing but stunted sorrel and spurrey.

Electrification Experiments.

The results of experiments carried out at Garforth showed that the electrification of the atmosphere brings about a heavier deposition of soot particles, and that these soot particles acted as nuclei of condensation for other smoke products.

Parts per Million

	<i>Electrically treated</i>	<i>Untreated.</i>
Suspended matter	270 8	81 0
Tar	15 3	3 8
Acidity as H SO ₄	10 3	10·6
Sulphur as SO ₂	33 2	15 6
" SO	7 2	0 36
Chlorine	24 9	10 3
Nitrogen as NH ₃	4 120	1 481
" N O ₂	0 813	0 493
" albuminoid ammonia	0 434	0 167
Total nitrogen	5 367	2 041

If these results generally hold good, they indicate that while the electrification of plants may prove beneficial in the rural districts, the process cannot be used to advantage in the districts where its value might be greatest, such as the market gardening districts in the neighbourhoods of the industrial areas. In such areas the intensified smoke effects would more than counterbalance the good effects which would otherwise result from the electrical treatment

Summary of Conclusions.—The main detrimental effects of air pollution by coal smoke upon vegetation may be summarised as follows —

1. The cloud of smoke blocks out the sunlight, and thus reduces the available solar energy by, in some cases, as much as 40 per cent.

2. The thick deposit on the leaves of plants and trees, still further blocks out the light.

3. The choking of the stomata by the tarry, glutinous matter tends to asphyxiate the plant, and effectively to check its power of assimilation of carbon dioxide.

4. The presence of free acids in the air tends generally to lower the vitality of the plant.

5. The free acids falling on the soil make it sour, and thus limit the activity of the soil organisms, which must work freely, if the soil is to maintain its fertility.

While it is only possible to reduce the first three effects of smoke pollution enumerated above by checking the output of smoke, and using every effort to lessen the air pollution, the remedy for the last lies in the hands of the farmers themselves.

The acidity of the soil can be neutralised by a *judicious application of lime*; in a smoke-infested area a dressing of lime at least once in a rotation should be regarded as essential, and the lack of such dressings has been responsible in many cases for the failure of a crop, particularly of roots and barley.

DECAY IN POTATO CLAMPS DUE TO "BLACK-LEG,"

S. G. PAINE and C. M. HAENSELER,

*The Department of Plant Physiology and Pathology,
Imperial College, London.*

THE very large amount of rotting of potatoes in storage which occurred throughout the country, and especially in the Fen district, during the early winter of 1918, led the Board of Agriculture to investigate the cause of the trouble, and Messrs. A. D. Cotton and H. V. Taylor, officers of the Ministry, made a thorough inspection of the clamps in the districts most affected. An account of this inspection, with the first impressions of the investigators as to the causes of the decay, together with a complete discussion of the general question of decay of potatoes in clamps, are contained in an article which appeared in a Supplement (No. 18) entitled "The Cultivation, Composition and Diseases of the Potato," published with the issue of this *Journal* for March, 1919.* One of us (S. G. P.) was asked to be present during the last inspection, when two farms in the neighbourhood of Spalding, Lincolnshire, were visited.

The clamps on these farms were not the worst cases that were seen, but their condition was extremely bad; wreaths of "steam" were rising in the winter air to a height of 4 or 5 ft. above the tops of the clamps, and, after removal of the straw, a thermometer was inserted to a depth of 9 in. amongst the topmost potatoes, and registered a temperature of 60° C. In one instance the top of the clamp had subsided in lengths of 10 to 30 ft. as a result of the conversion of the potatoes into a condition of sludge. When the clamps were opened, many of the potatoes at the top were sweet-smelling but soft in texture, and appeared to be par-boiled, but otherwise unaffected. Large quantities, however, were reduced by bacterial action to a stinking pulp. Several specimens of the tubers which were least diseased were collected for bacteriological examination. These were found to contain a very mixed bacterial population, in which saprophytic forms, such as *Bacillus mesentericus*, *B. subtilis* and *B. mycoides* predominated. Portions of the pulp were placed upon sterile slices of potato and maintained at different temperatures; at room temperature there was,

* Copies of this Supplement may be obtained on application to the Secretary, Ministry of Agriculture and Fisheries, 3, St. James's Square, London, S.W. 1, price 6d. net.

apart from a few exceptional cases, no effect beyond the softening of the surface tissue to a depth of one or two millimetres. At 20° C., in every case the whole of the tissue rotted completely in three or four days. The colour of the rotted tissue was at first quite white, but became greenish-yellow on the second day and remained this colour for seven or eight days, when the colour changed to pink.

From the greenish-yellow tinge of the tissue *B. xanthochlorum* (Schuster) was suspected as the cause of the decay, but on transferring repeatedly from the margin of the diseased area to fresh potato slices this colour was observed to become less prominent, and it eventually failed to appear at all. The rotting effect continued actively in the absence of the yellow-producing organism, which was evidently a saprophyte. The character of the rotted tissue indicated the "Black-Leg" bacillus (*B. atrosepticus*) as the causal organism. The rotted tissue was perfectly white in the unexposed portions and fleshy-pink at the surface, where it was exposed to light and air. Platings which were made from these rotted potato slices gave pure cultures of an organism which agreed in morphological characters with *Bacillus atrosepticus* and gave also all the reactions by which this organism is recognised. Inoculations of potato stems and bean stems gave rise to the symptoms of "Black-Leg," thus leaving no doubt as to the identity of the organism.

"Black-Leg" is well known as a cause of rotting in stored potatoes. The disease had not been observed by the farmers in the fields from which these crops had been taken, but this signifies little, since it is well known that a late attack of "Black-Leg" will not show itself to any very obvious extent in the "tops," and the presence of the organism in the tubers can only be recognised by cutting the tuber longitudinally through the "heel."

From the cultural experiments recorded above it is certain that the "Black-Leg" bacillus was largely responsible for the damage in the particular cases investigated, but the question as to whether it was responsible for the commencement of the trouble or whether one of the other agencies enumerated by Cotton and Taylor was concerned must be left open. It is also unknown whether the presence of *B. atrosepticus* was general in the rotted potatoes throughout the country, but it is, at least, significant that trouble from "Black-Leg" was worse than usual during the past summer.

In order to prevent losses during storage it cannot be too strongly emphasised that extreme care should be paid to the construction and ventilation of the clamps. The practical suggestions given by Cotton and Taylor on pages 58 and 59 in the article referred to above, should be closely followed. The main safeguard is to keep the potatoes dry and well aired. A method of ventilation in common use in Germany, but scarcely ever seen in this country, consists in the laying of poles along the ridge of the clamp after the first layers of straw have been spread over the potatoes. Further layers of straw are laid over these poles, and finally the earth casing is put on the clamp. Channels on either side of the poles, running the length of the clamp, and open to the air at both ends, are thus provided. The ready entrance of rats and mice into these open ends should be prevented by means of galvanised wire netting of suitable mesh.

IDEAL HOMES EXHIBITION : THE MINISTRY'S MODEL ALLOTMENT.

In pursuance of a definite policy of Horticultural Education, the various County Authorities in England and Wales have been approached by the Ministry and asked to set up special committees whose duty should be the fostering of commercial and domestic fruit and vegetable cultivation to meet the requirements of the respective counties.

With the object of making suggestions as to the lines on which demonstration plots might be set up, special plans dealing with allotments, market-gardening and fruit have been sent to each County Authority. Many of the counties have already adopted the scheme in its entirety, and others have modified it to suit the particular types of cropping most suited to districts in which the plots have been set up. It is hoped that eventually every County in England and Wales will carry out some portion of the scheme.

In the case of the allotment, the scheme should have a practical application to every part of the country, and although the summer, autumn and winter cropping will have to be modified to suit the altitude, latitude and general climatic conditions prevailing in different districts, the arrangement of the general crops will hold good over the whole country.

Towards the close of 1919, the *Daily Mail* approached the Ministry with a view to obtaining suggestions for the cropping of a vegetable plot which might be worked by the prospective tenants of the types of cottage to be shown at the Ideal Homes Exhibition in February. It was suggested by the Ministry that the model allotment showing the cropping, soil preparation and manuring, as these operations appear in the month of February, would be a suitable exhibit. This was provisionally offered, but when the promoters of the Exhibition approached Messrs. Sutton & Sons of Reading, that firm immediately proposed to produce the full cropping scheme as it would appear in June under normal climatic conditions.

Although only five weeks were available to get the crops ready, the allotment appeared on 4th February fully cropped as it should appear in June. It proved a source of great interest to those visiting Olympia, and was undoubtedly of great educational value. Addresses were given each evening.

and the interest and enthusiasm manifested by the large audiences which attended were ample recompense to all concerned.

Questions were numerous, and copies of the Ministry's leaflets dealing with horticulture were distributed at the Exhibition.

The plan and photographs will give some idea of the principles on which the cropping is based and the general appearance of the plot with the crops in full growth.

Potatoes were earthed up, leeks and celery were in their trenches, peas were almost in bloom, and runner beans were starting to climb their sticks. Onions, beet, carrots, parsnips, turnips, marrows and shallots were all several inches high, while rhubarb, spring cabbage and lettuces were ready for gathering. The whole plot was surrounded by an edging of turf which gave a pleasing and natural finish to the exhibit. The crops on the allotment are so managed as to admit of one-third of the entire area becoming vacant each year to allow a portion to be "double-dug" or bastard trenched, but this does not do away with the necessity for deep working of the entire area when the allotment is first broken up. A three years' rotation is shown on the plan.

Provision is also made for the sowing of crops which may be dug into the ground in the green state to meet the great and ever increasing shortage of farmyard or corporation manure. The general application of artificial manures in the various sections is also indicated.

Everything connected with the exhibition was intended to be educational. Thousands of people examined the plot and listened to the lectures, and from the general trend of the questions asked, there would appear to be still an *appalling amount of ignorance with regard to soil working, manuring and general cultivation*. There is, therefore, a very large field of work open to County and Municipal Authorities in educating the allotment holder and thus raising the standard of cultivation all over the country. It is quite safe to assume that, taken as a whole, not over 50 per cent. of the possible tonnage per acre is at present being obtained from allotments, although there are outstanding cases where almost maximum returns are being secured. Allotments were increased during the War from 500,000 to 1,500,000, and despite the fact that many war areas have had to be given up, the present allotments in England and Wales are computed to aggregate 1,750,000 and are still increasing. This is ample proof that the so-called

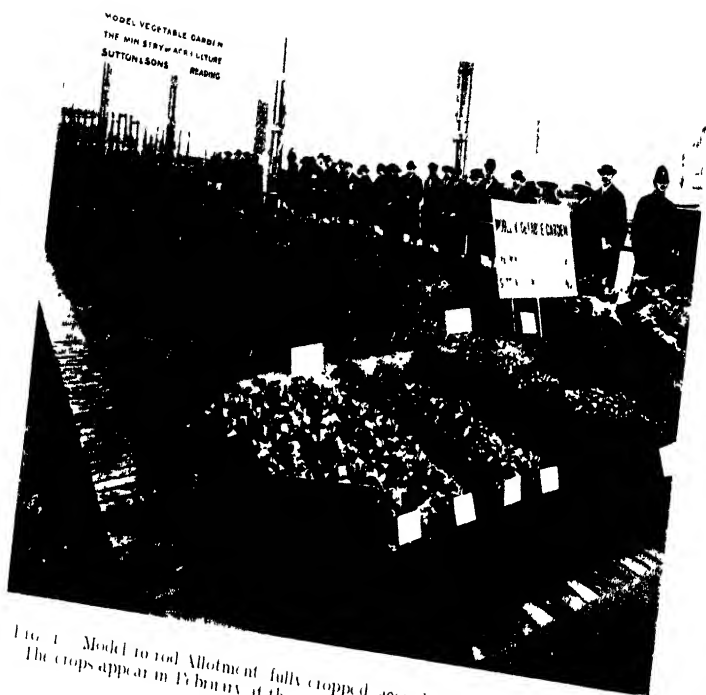


FIG. 1.—Model to root Allotment, fully cropped, according to the Ministry's plan. The crops appear in February at the stage of growth usually obtaining in June.



FIG. 2.—Fruit Tree and Bush Fruit Exhibit at Olympia, February, 1920 (Illustrating correct and faulty methods of pruning.)



FIG 3.—Bush Apple Tree (9 years old) On Paradise Stock judiciously thinned and systematically pruned

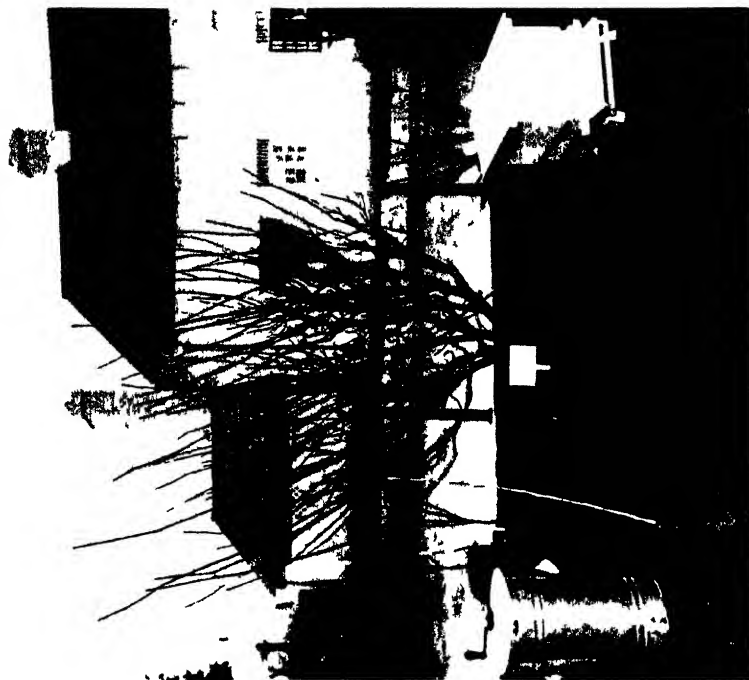


FIG 4.—Bush Apple Tree (9 years old) On Paradise Stock showing neglected condition from lack of pruning over a period of years.

war craze for food production has not been a spasmodic or temporary effort, but has come to stay, and that the number of allotments is likely to continue to increase in the future.

To raise their productivity by even 20 to 30 per cent. is a work well worthy of the efforts of the Ministry, and it is hoped to accomplish it by combining systematic lecture courses and practical demonstration work (by means of model plots) with private effort. The value of the extra produce would run into millions of pounds sterling, and the general commercial market-gardening of the country would not be detrimentally affected.

The allotment movement has been responsible for a greater consumption of vegetables amongst the working classes, and in thickly-populated areas householders not possessing allotments have vied with their neighbours and purchased on the open market to a greater extent than previously to furnish a greater variety for the table.

All this has tended to the national good and helped to build up a healthier and more independent population. The social and moral influences of the allotment movement may possibly prove incalculable, for no man can cultivate properly a small piece of ground without being brought face to face with the problems of nature and being made to think, and in the majority of cases the effects of the environment of the allotment will be to make him a better man intellectually and socially.

Fruit Tree and Fruit Bush Exhibit.—Being aware of the ignorance which exists amongst amateurs and small holders generally with regard to the pruning of fruit trees and bushes, the Horticultural Division of the Ministry arranged with Messrs. Spooner of Hounslow to exhibit a certain number of specimens which they considered would prove of educational value. The trees were pruned by the Ministry's experts and have been carefully examined by great numbers of those visiting the exhibition.

The demonstrations were so apparent as to appeal at sight to the novice, but all were labelled in bold type with the object of enlightening cottagers and villa gardeners who possess a few specimens or who may desire to plant their gardens in the near future.

Bush apple trees were shown on the Paradise stock as they usually appear when purchased from the nursery, and during the first, second, third, and fourth year of their growth. In each case the pruned and unpruned specimen was shown. In addition, the novice was shown a neglected bush apple

tree, nine years old, similar to thousands which can be found in rural suburbs, while alongside a similar tree, renovated by judicious thinning out of the branches and pruning of the laterals so as to bring it into a profitable fruit-bearing condition, was shown.

The formation of a half standard apple, plum and pear, was illustrated by pruned and unpruned specimens.

Small fruits were represented by two-year-old gooseberry, and black and red currant bushes, illustrative of the method of cutting down after planting. A neglected gooseberry and black currant bush were also shown, with a similar bush pruned systematically. Modern types of cordon gooseberries and red currants pruned and unpruned occupied one section of the exhibit.

The trees and bushes were inserted in pots and tubs and carefully mossed over, and the whole was set on a ground-work of red gravel giving a clean and pleasing effect to the whole exhibit.

The enthusiasm displayed and the information imparted would appear to justify similar procedure at other large shows or exhibitions in the provinces.

AGRICULTURE ABROAD.

RECLAIMING HEATH LAND IN DENMARK—SETTLING EX-SERVICE MEN IN NEW SOUTH WALES— IMPROVING GRASS LAND IN BAVARIA.

THE wave of patriotic feeling which swept over Denmark after the disastrous war of 1864, when North Schleswig passed into the hands of Germany, was the primary cause of the formation of the Danish Heath Society. Through the initiative of Colonel E. M. Dalgas a scheme was prepared in 1866 for the reclamation of the uncultivated land in Jutland. Thousands of people came forward to support the scheme, and subscriptions and donations were given by many communal authorities, saving banks, joint stock companies, and other bodies. Subsequently the Danish Government recognised in a practical manner the valuable work done by the Society, and since 1885 State grants have been made towards the cost of making plantations. The Society has become an agent of the State, and large sums of public money are administered by it. In 1918 State grants amounted to 2,102,856 kr. (about £115,657), whilst subscriptions from members, who now number 9,416, amounted to 47,991 kr. (about £2,640).

The object of the Society is to encourage the cultivation of heath land in Denmark, and although this has been done mainly by instruction, the Society has also embarked directly on many and varied projects. The first and most important was the acquisition of land on its own behalf. Wherever possible this land was prepared and cultivated with ordinary farm crops, but poor land was utilised for the laying out of plantations. Marshes were drained; dry land was irrigated; marl pits were opened in order to provide a plentiful supply of marl and lime for improving the soil; and the transport necessary for the opening up of large areas was provided by the construction of light railways. Later still came the distribution of young plants, at cheap rates, to small holders and farmers.

The Society's field of action, formerly confined to Jutland, now extends over the whole of Denmark. In Jutland alone there existed in 1860 an area of about 2,900 square miles of uncultivated land, either heath or marsh. This area has now been reduced by more than one-half, mainly owing to the work of the Society, though the Danish Government has assisted by the laying out of State plantations.

The number of plantations now under the direction of the Society is 2,232, covering an area of about 195,000 acres. The problem of utilising the wood thus grown was solved in certain cases by the installation of charcoal burning plant, and by the extraction of tar. A considerable trade has also been developed in supplying fence poles and other forms of light timber. Large numbers of young trees, coniferous and deciduous, have been grown on the various plantations, and for a number of years between ten and twelve million plants have been distributed annually.

The search for marl was one of the early labours of the Society, as it was recognised that large areas would require some form of manure to render the soil fertile, and the transport of this by light railway was begun in 1875. The subsequent expansion by the Society of the system of movable light railways was of importance. Up to the end of 1915 the amount of marl transported was about 1,300,000 tons, and the amount of lime about 160,000 tons.

The drainage and cultivation of marsh land took an important place among the activities of the Society. Irrigation canals were made, drainage systems were evolved, embankments and dikes were constructed, and plans and assistance given to a large number of small farmers. About 270 miles of irrigation canals have been made for the improvement of about 17,500 acres of land. Extensive schemes of drainage have been put into operation, and the construction of embankments protects large areas from becoming useless stretches of water-logged land. The institution of numerous demonstration stations and of three large permanent experimental stations has enabled the Society to maintain this important work. From these stations are issued large numbers of plans and instructions for the benefit of small holders who are in a position to carry out improvements on their own behalf.

In the success of the Society's work the co-operation of the individual owner or occupier of the heath land has been a contributing factor of the utmost importance. This has been fostered to a large extent by the educational system obtaining in Denmark, which aims primarily at implanting a love of rural life in the minds of the young. Subsequent training in the advanced schools tends further to develop a taste for those agricultural pursuits which demand a full measure of the national traits of thrift, industry and neighbourliness.

SPECIAL legislative measures have been provided by the Government of New South Wales to assist in the settlement

**Land Settlement
in New
South Wales.**

upon the land of persons who have completed their service in the Army or Navy during the War. Large areas of Crown lands have been made available and several large estates have been acquired by purchase, while others are in course of acquisition. On these estates group settlements have been or will be established in order to accommodate communities of soldiers, each soldier having his own individual farm or holding.

In certain cases privately-owned property may be selected by a discharged soldier, and purchased for him by the State. The settler in such cases is required to reside for at least five years on the land and to effect improvements up to stated percentage minimum values.

To meet the requirements of some of those who have not had practical experience, a training system has been inaugurated in conjunction with the Department of Agriculture, and expert officials are available for guidance and advice. Such training, however, will only provide for a very limited number.

In order to help those who may wish to take up poultry-farming, but who may not have had sufficient experience, and also in order that a supply of birds of good quality may be available, a stud poultry-farm has been purchased to serve as a training farm. A state nursery and training farm has also been established at Glen Innes, at which general horticultural work is taught.

Advances up to a maximum amount of £625 are made to provide for the equipment of the farms and to effect the necessary improvements. The terms of repayment of moneys advanced for this purpose, and of payment for the land, are upon a long-deferred system, the instalments being calculated upon an interest basis of not exceeding $3\frac{1}{2}$ per cent. for the first year, 4 per cent. for the second year, and so on, the rate increasing by not more than one-half per cent. for each subsequent year, to a maximum of $5\frac{1}{2}$ per cent.

On certain classes of holdings fortnightly payments are made during the unproductive period to sustain the settler and his family. Such an advance must be repaid by the settler. Sustenance may also be obtained from the Department of Repatriation for a period not exceeding six months in the first two years of occupation if the circumstances so warrant.

Soldiers travelling to inspect land that has been made available and which it is proposed to be used for settlements under the Returned Soldiers' Settlement Act are allowed to travel free on one return journey only.

* * * * *

THE object of this Society is to unite farmers and owners of grass land in an endeavour to promote the improvement of meadows and pastures and fodder crops generally, in co-operation with the Government.

Society for the Improvement of Grass Land in Bavaria.*

The following are the measures to be taken for the furtherance of this object :—

1. Expert advice and consultation in laying down, cultivating and improving grass land and fodder crops generally.
2. The institution and maintenance of training and experimental centres, and model farms.
3. The establishment of breeding and seed growing stations for the improvement of the local meadow and pasture grasses and other fodder plants.
4. The promotion of common grazing grounds in the interests of small stock-owners.
5. The promotion of sheep pastures.
6. Expert advice and consultation in all questions of manuring.
7. Expert advice and consultation in farm management generally, where questions of grass land farming are involved.
8. Supply of seed and all other necessities.

The Society's first lectures were given on 5th and 6th January last, and in spite of difficulties of travelling were attended by some seventy farmers from all parts of Bavaria.

* *Deutsche Land. Presse*, 4th February, 1920, p. 76.

QUESTIONS IN PARLIAMENT.

Ploughing Up of Winter Wheat.—In reply to a question by Mr Royce, the Parliamentary Secretary to Ministry of Agriculture stated that he was not aware that any farmers intended to plough up their winter wheat, but that he had heard that some farmers proposed to cross-drill their wheat with barley or oats to secure a crop of mixed corn, which could be used for stock feeding. Such action would not constitute any offence against the law, but was to be deprecated as being contrary to the national interest. (9th March 1920.)

Muzzling Order.—In reply to a question by Captain Tudor Rees, the Parliamentary Secretary to the Ministry stated that the last case of rabies occurred in Surrey on the 18th February. The Muzzling Orders were at present in force in six different parts of the country. Owing to the abnormally long incubation period which sometimes occurs in rabies, it was not considered safe to free a muzzling area within a period of from six to eight months from the date of the confirmation of the last case. (15th March, 1920.)

Land Settlement.—In reply to a question by Commander Locker-Lampson, the Parliamentary Secretary to the Ministry stated that according to the latest returns received from the Huntingdon County Council, 973 applications had been made to the Council for 16,115 acres. Of these applicants, 692 had been approved for 7,265 acres and 522 had actually been provided with holdings having a total area of 4,549 acres. As regards 219 applicants for 3,569 acres their applications were standing over either for the purpose of interview or for some other reason. Fifteen other counties had received a larger number of applications for small holdings than Huntingdon, and one county (Isle of Ely) had settled a larger number of men but he was glad to have this opportunity of congratulating the Huntingdon County Council on the work which they had accomplished in regard to land settlement. He further stated that arrangements had been made in accordance with Section 18 of the Land Settlement (Facilities) Act, 1919 for the Huntingdon County Council to guarantee advances to their tenants for the purchase of live stock fruit trees seeds fertilisers and implements, and in these circumstances he was not aware that the establishment of a land bank was necessary at the moment. (15th March 1920.)

Tillage.—In reply to a question by Major Howard the Parliamentary Secretary to the Ministry stated that the total area of land of which the Agricultural Executive Committees are in possession under the Defence of the Realm Regulations is 32,000 acres of which 12,000 acres are let to farmers and 20,000 acres are being farmed by the Committees themselves. (22nd March, 1920.)

Tuberculosis Order of 1913.—In a reply to a question by Lieut. Colonel Fremantle respecting the Tuberculosis Order of 1913, the Parliamentary Secretary to the Ministry stated that it was anticipated that the Tuberculosis Order, either in its present form, or slightly amended would come into operation at the same time as the Milk and Dairies Act. The question of employing whole time veterinary surgeons was under consideration, but the matter was one which presented serious difficulties. The Ministries of Health and Agriculture were acting in close co-operation in this matter, and the possibility of introducing a system whereby herds might be guaranteed free from tuberculosis was under consideration. (15th March 1920.)

NOTICES OF BOOKS.

Village Clubs and Halls.—Sir Lawrence Weaver, K.B.E. (London: Offices of "Country Life," 1920, 7s 6d net) The object of this book is to present to persons interested in the question of the building of village halls and clubs a number of plans and designs of diverse character in their size, cost of equipment, and architectural treatment, which should be useful for consideration in the construction of such buildings. Illustrations are freely given to illustrate the subject of the text matter. The author first deals generally with the place a club should occupy in the social life of a village, and refers to the Village Clubs Association. He elaborates his subject by treating in detail the construction of halls and clubs, and touches on the cost of erection materials, and other relative factors. Two chapters are given describing the Kemsing Village Club and the Nettlebred Working Men's Club and Institute, which are quoted as model examples. Appendices are added on (1) How to form a village club, (2) draft rules of village clubs, (3) advantages of affiliation to the Village Clubs Association, (4) Memorandum on educational facilities, and (5) a financial statement on the working of the Nettlebred Working Men's Club and Institute during 1918.

A Course of Practical Chemistry for Agricultural Students, Vol. I—H. A. Neville and L. F. Newman (Cambridge: University Press, 1920, 10s 6d, net). Vol. II., Part I of this work which was noticed in this *Journal* for February, 1920, p. 1140, contains exercises in pure organic chemistry. The volume now under review is intended to cover the first year's course on the chemistry and physics of the soil and is based to some extent on the course of practical work compiled by Prof. T. B. Wood some years ago for the use of his classes at Cambridge. The exercises are designed to illustrate most of the essential points in agricultural chemistry, and require a minimum of apparatus.

Animal Foodstuffs: Their Production and Composition, with a special Reference to the British Empire.—E. W. Shanahan (London: George Routledge & Sons, Ltd. 10s 6d net) This is one of the Studies in Economics and Political Science edited by the Director of the London School of Economics and Political Science. The first part is devoted to an examination of the conditions of production of meats and dairy and poultry produce in all the important countries, in the course of which it is shown that, even apart from the effects of the War, there was, and is, a growing tendency towards a world-shortage of these foodstuffs.

The second part discusses the various aspects of the question of the consumption of these articles separately and together, and examines the economic relations that exist between the production and consumption in keeping with the technical organisation of agriculture.

The third part deals with these questions within the British Empire, and shows how the existing deficiency may be partly overcome. There is an exhaustive reference index and bibliography.

Ordnance Survey Maps.—Landowners, farmers and all connected with the land will find the large scale Ordnance Maps of exceptional value. The maps on the scale of 25 in. to the mile show hedges, walls, fences, ditches, roads, paths, streams, houses, woods and orchards, in fact every feature of the countryside, whether natural or artificial.

The acreage of each field or enclosure is also shown. For trifling sums, owners or occupiers of land can obtain thoroughly reliable maps of their properties.

The price per sheet of these large scale maps is 5s. The Ordnance Survey also publish maps on the scale of 6 in. to the mile, quarter sheets of which are priced at 1s 6d.

Several editions of excellent maps on the scale of 1 in. to the mile, and on smaller scales, are also published at prices ranging from 1s. to 3s. each. All roads are shown; in the coloured editions, these are classified by means of distinctive colouring according to the nature of their surfaces, including suitability for fast traffic. Footpaths, towns, villages, railways and stations, rivers, streams, parks, woods, county boundaries, high and low watermark, are all accurately delineated. The whole country has been completely surveyed, and the maps are kept up to date by a system of periodic revision. They are specially useful for accuracy of detail and are of the greatest value to those who desire to possess an accurate knowledge of any district or locality in which they are specially interested. The maps can be purchased through any bookseller or stationer, or direct from the Director-General, Ordnance Survey Office, Southampton.

Report of the Departmental Committee on Agricultural Machinery.—(Cmd. 506, London: H.M. Stationery Office, 1920, 1s. net). This Committee was appointed by the President of the Board of Agriculture and Fisheries, in May, 1919, to arrange for the testing, adaptation and improvement of machines likely to prove of value to agriculture, to examine inventions and new devices, and to advise as to the further steps which should be taken to promote the development of agricultural machinery.

The Report now published deals with the last part of these terms of reference. The Committee heard evidence from all parties interested in the question of agricultural machinery, and have dealt at some length with various aspects of the problem, including research, testing, co-operation, education and propaganda. An Appendix to the Report contains an outline of the principal steps taken in certain countries abroad to promote the development and use of agricultural machinery.

In another part of this issue (pp. 1 and 2) the recommendations of the Committee are summarised.

Sugar Beet Growing in England.—Much interest is at present being taken in the question of the growth of sugar beet, and the possibilities of the establishment of a beet sugar industry in England as a result of the high price of sugar, the adverse rate of exchange and the insistent demand for increased production of essential food-stuffs. It has, therefore, been thought desirable to set out clearly the present position.

Quite apart from the question of the production of sugar, sugar beet is a useful crop to grow; it would occupy the same place in the rotation as roots without materially, if at all, reducing the supply of succulent food for stock; both leaves and by-products make excellent food for cattle; and the careful and thorough cultivation necessary for the best results reacts favourably on the subsequent crops of the rotation. It has the further important advantage of giving a direct monetary return for its cultivation. Extensive trials conducted before the War have already indicated the suitability of many parts of the country for production of beet on a large scale for manufacture into sugar, but owing to the bulky nature of the crop and the consequent high cost of transport, it must be definitely understood that its growth for the extraction of sugar on a commercial scale is only advisable within reasonable transport distance of a factory.

A beet sugar factory is to be erected on the Kelham Estate in Nottinghamshire,* but there is little likelihood of the factory being completed this year. The Government are financially interested in this enterprise, as they have agreed to take up an equal number of shares with the public up to a maximum value of £250,000 in the company ("Home Grown Sugar, Limited") which has been formed to control the enterprise. The Treasury have a financial representative on the directorate of the company. The nominal capital is to be £1,000,000. £500,000 will be issued and shares to the value of £250,000 have been subscribed by the general public. Communications from farmers with regard to the scheme should be addressed to the Secretary, Home Grown Sugar, Limited, 14, Victoria Street, London, S.W. 1.

There is a sugar factory at Cantley near Norwich, which closed down in 1916 owing to war conditions, but which, it is understood, is now being re-opened. The Ministry understands that new processes are to be installed at the factory, and the machinery overhauled, and it is proposed, by alterations to the plant, to refine cane sugar in periods when beet sugar factories usually stand idle. Inquiries with regard to the growth of beet for this factory should, for the present, be addressed to J. Crosland Graham, Esq., 3, Stanley Street, Liverpool.

A memorandum of the Cultivation of Sugar Beet has been prepared by the Ministry. Copies may be obtained free on application at 72, Victoria Street, London, S.W. 1.

Foot-and-Mouth Disease.—No outbreak of Foot-and-Mouth Disease has been confirmed in Great Britain since the 27th February, on which date there were two outbreaks, one at Ripple (near Tewkesbury) Worcestershire, and one near Wendover, Buckinghamshire. By an Order of the Minister which came into operation on the 29th March, all the remaining general restrictions on the movement of animals, which were imposed by the Ministry in connection with the above and other outbreaks, were withdrawn.

* See note in this *Journal*, January, 1920, p. 1000.

Rabies.—No fresh case of Rabies has been confirmed in Great Britain since the 18th February last, the date of the case mentioned in last month's issue of the *Journal*. All muzzling and movement restrictions remaining in force in the Plymouth Area were withdrawn by an Order which took effect on the 29th March. The metropolitan muzzling area has also been further reduced.

Agricultural Executive Committee and Cultivation of Land Orders.—

The Somerset Agricultural Executive Committee recently prosecuted an owner of land for failing to comply with a Cultivation Order served in June last, requiring the land to be ploughed and cleaned by the 2nd of September. The defendant's solicitor pleaded guilty on behalf of his client, but urged in extenuation of the offence that the land was purchased with the object of selling it again, not with the intention of cultivating it, and that delay had occurred in finding purchasers suitable to his client. The Bench imposed a fine of £25 with £10 10s. costs.

An Order determining the tenancy of five fields in the West Riding of Yorkshire has been issued in consequence of the neglected condition of three arable fields comprised in the holding. The West Riding Agricultural Executive Committee state that the Cultivation Orders they have served on the tenant, and the warnings they have given him on many occasions, have had no effect on the state of the cultivation of his land.

A prosecution for disregard of Cultivation Orders issued by the Surrey Agricultural Executive Committee was heard at Guildford on the 12th March. The Orders in question were issued in October and November, 1918, and required that certain arable fields should be cleaned and cultivated in preparation for food crops for the harvest of 1919. Practically nothing was done, however, to carry out these Orders up to the end of 1919. The occupier of the land was fined £50, and his agent, £10. Notice was given that an Appeal would probably be lodged.

Poultry and Egg Prices.—The Poultry and Game (Prices) Order, 1918,* was revoked as from Monday, 22nd March, and as a result all British poultry and game are now free from control.

The Eggs (Prices) Order, 1919†, was also suspended from Monday, 22nd March.

Price of Sugar for Bee-feeding.—The Ministry has been in frequent communication with the Royal Commission on the Sugar Supply on behalf of bee-keepers, and has been informed that the Commission are unable to reduce the price of sugar for bee-feeding below the economic price, or below that at which it is sold for purposes other than grocery and the manufacture of jam, as this would, in effect, be equivalent to paying a subsidy to the bee-keeping industry.

The Ministry regrets this decision, but in view of the general increase in price, bee-keepers cannot expect to receive preferential treatment.

* See this *Journal*, January, 1920, p. 1033.

† " " December, 1918, p. 1128, and January, 1920, p. 1033.

ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous—

Ministry of Munitions of War.—Nitrogen Products Committee: Final Report. (357 pp.), [Cmd. 482], London: H.M. Stationery Office, 1920, 4s. net. [63.1671; 668.6.]

Sierig, Dr. Ewald.—Die Moorkultur, ihre volkswirtschaftliche Bedeutung und Durchführung. (126 pp.), Berlin: Paul Parey, 1913. [63.142.]

Field Crops—

B. E. Africa Department of Agriculture.—Bulletin 4.—Wheat in East Africa. (16 pp.), Nairobi, 1919. [63.311(04).]

West of Scotland Agricultural College.—Bulletin 95.—Report on Sugar-beet Trials, 1918. (5 pp.), Glasgow, 1919. [63.3432.]

Scandinavian Seed Company and R. Wibolt.—Rules of Proceedings in Determination of Dry Matter in Beet-roots. (4 pp.), Copenhagen: Johann Ullstad, n.d. [63.3432.]

Horticulture—

Brannit, W. T.—A Practical Treatise on the Manufacture of Vinegar and Acetates, Cider and Fruit Wines, and the Preservation of Fruits, Vegetables, etc. 3rd Ed. (543 pp.), Philadelphia: Henry Carey Baird & Co., 1914, 35s. [663(a), 663.3, 664.8.]

Live Stock—

Board of Agriculture and Fisheries.—Part II. of the Report of the Army Cattle Committee. (7 pp.), London: H.M. Stationery Office, 1919, 2d. net. [63.6(42).]

Board of Trade.—Report of Inter-Departmental Committee on Meat Supplies. (29 pp.), [Cmd. 456], London: H.M. Stationery Office, 1919, 3d. net. [63.6(42).]

Dairying and Food, General—

National Clean Milk Society.—Lecture on the National Importance of a Clean Milk Supply and How to Obtain It. (11 pp.), London, 1919, 6d. [614.32.]

Sammis, J. L.—Cheese Making: a Book for Practical Cheesemakers, Factory Patrons, Agricultural Colleges, and Dairy Schools. (225 pp.), Madison, Wis. Mendota Book Co., 1918. [63.73(02).]

Birds, Poultry and Bees—

Canada, Dept. of Mines, Geological Survey.—Memoir 104.—Birds of Eastern Canada. (297 pp.), Ottawa, 1919, 50 cents. [59.82.]

Engineering—

Page, V. W.—The Modern Gas Tractor: Its Construction, Utility, Operation and Repair. (504 pp.), New York: N. W. Henley Publishing Co., 1918, \$2.00. [63.175.]

Board of Agriculture and Fisheries.—Manual for the Guidance of County Councils and their Architects in the Equipment of Small Holdings: Part I., Planning and Construction of Cottages. Part II., Planning and Construction of Farm Buildings. (53 pp.), London: H.M. Stationery Office, 1919. 1s. 6d. net. [69(02).]

Economics—

Switzerland, Secrétariat des Paysans.—Recherches relatives à la Rentabilité de l'Agriculture suisse, pour 1917-18. (249 pp.), Lucerne: Keller, 1919. [63(494).]

Ministry of Reconstruction.—Fourth Report of the Acquisition and Valuation of Land Committee on the Transfer of Land in England and Wales [Cmd. 424]. (48 pp.), London: H.M. Stationery Office, 1919. 6d. net. [347.; 333.]

Central Landowners' Association.—Memorandum on the Tithe Act, 1918. (4 pp.), 1919. [348.]

- Central Landowners' Association*.—Memorandum on The Nationalisation of Agricultural Land. (9 pp.), 1919. [333.]
- Mitchell, E. L.*—A Handbook of the Law of Allotments (England and Wales), with Rules and Regulations of the Board of Agriculture and Fisheries. (100 pp.), London. Cable Printing and Publishing Co., 1919. 6s. net. [347(b).]
- Board of Agriculture and Fisheries*.—Report of Sub-Committee appointed to consider the Employment of Women in Agriculture in England and Wales. (121 pp.), London. H.M. Stationery Office, 1919. 1s. 6d. net. [331(c).]

SELECTED CONTENTS OF PERIODICALS.

Agriculture, General and Miscellaneous—

- Scottish Agriculture during the War, *C. Douglas*. (Trans. High. and Agric. Soc., Scotland, 1919.) [63(41)]
- The Carbonation of Burnt Lime in Soils, *W. H. MacIntire*. (Soil Science, May, 1919.) [63.15.]
- The Washing out of Nitrates by Drainage Water from Uncropped and Unmanured Land, *E. J. Russell* and *E. H. Richards*. (Jour. Agric. Sci., January, 1920.) [63.1671; 63.112.]
- The Relations Existing between the Soil and its Water Content, *B. A. Keen*. (Jour. Agric. Sci., January, 1920.) [63.112.]
- Tropical Departments of Agriculture, with special Reference to the West Indies, *Sir F. Watts*. (Jour. Roy. Soc. Arts, 20th and 27th February, 1920.) [35(729); 63(024).]
- Seed Studies: Red Clover with special Reference to the Country & Origin of the Seed, *R. G. Stapledon*. (Jour. Agric. Sci., January, 1920.) [63.33(b); 63.1951.]
- The Determination of Ammonia in Soil, *D. J. Matthews*. (Jour. Agric. Sci., January, 1920.) [63.113.]

Field Crops—

- Sunflower Silage, *R. E. Neideg* and *L. E. Vance*. (Jour. Agric. Research, 15th December, 1919.) [63.1985, 63.342.]
- Restoration of Land to Pasture, *W. J. Proffert* and *W. M. Findlay*. (Trans. High. and Agric. Soc., Scotland, 1919.) [63.33(a)]
- Manuring for Milk, *J. M. Adams*. (Jour. Dept. Agric., Ireland, Vol. XX., No. 1, 1919.) [63.33-16.]
- The Growing of Storage Crops on Dairy Farms in Denmark, *H. Faber*. (Scottish Jour. Agric., January 1920.) [63.33, 63.191.]
- The Turnip Crop in Scotland, *J. A. Symon*. (Scott. Jour. Agric., January, 1920.) [63.332.]
- Flax Cultivation and Manipulation in Fife, *T. Young*. (Scott. Jour. Agric., January, 1920.) [63.34111.]
- Effect of Alfalfa on the Fertility Elements of the Soil, as compared with Grain Crops, *C. O. Swanson* and *W. L. Latshaw*. (Soil Science, July, 1919.) [63.33(c).]

Plant Diseases—

- European Frit Fly in North America, *J. M. Aldrich*. (Jour. Agric. Research, 2nd February, 1920.) [63.27.]
- Silver-Leaf Disease, *F. T. Brooks* and *M. A. Bailey*. (Jour. Pomology, Vol. I., No. 2, 1920.) [63.24.]
- A Phytophthora Rot of Pears and Apples, *H. Wormald*. (Ann. App. Biol., December, 1919.) [63.24.]
- On the Life History of "Wireworms" of the Genus *Agriotes*, Esch., with some Notes on that of *Athous* [*Haemorrhoidalis*, F. Part I., *A. W. Rymer Roberts*. (Ann. App. Biol., December, 1919.) [63.27.]
- A Contribution to the Life History of the Larch Chermes (*Cnaphalodes strobilobius*, Kalt.), *E. R. Speyer*. (Ann. App. Biol., December, 1919.) [63.27.]

- Studies in Bacteriosis, IV.—"Stripe" Disease of Tomato, *S. G. Paine* and *W. F. Bewley*. (Ann. App. Biol., December, 1919.) [63.24.]
 A Preliminary Study of the Rust Resistance of Oats, *J. H. Parker*. (Jour. Amer. Soc. Agron., January, 1920.) [63.24.]
 The Mosaic Disease of the Solanaceae: Its Relation to Phloem-Necrosis and its Effect on Potato-Culture, *H. M. Quanjor et al.* (Meded. Landbouwhoogeschool, Wageningen, Decl. XVII., Af. 1-3, 1919.) [63.27-33.]

Live Stock—

- The Origin of the Ayrshire Breed of Cattle, *C. Douglas*. (Trans. High. and Agric. Soc., Scotland, 1919.) [63.62.]
 Famous Clydesdale Sires (Second Series), *A. Macneilage*. (Trans. High. and Agric. Soc., Scotland, 1919.) [63.61.]
 Bracken Rhizomes and their Food Value, *J. Hendrick*. (Trans. High. and Agric. Soc., Scotland, 1919.) [63.604(a).]
 Weitere Untersuchungen über die Zusammensetzung und Verdaulichkeit einiger Kneigsfuttermittel (Pansenmschfütter, Leimgallertefutter, Maiskolbenschwot, Zuckerrübensamen, Ackerbohnenkleie, Nesselmehl und Zuckerrübenschwanze), *F. Honcamp, O. Nolte, and E. Bianck*. (Land. Versuchs-Stationen, Band XCIV., Heft 3 and 4, 1919.) [63.604(a).]
 Scottish Pure Bred Live Stock: II.—Shorthorn Cattle, *W. Mackay*. (Scott. Jour. Agric., January, 1920.) [63.62.]

Dairying and Food, General—

- Electro-Pure Process of Treating Milk, *A. K. Anderson* and *R. Finkelstein*. (Jour. Dairy Science, September, 1919.) [63.717.]
 The Mould of Blue-Veined Cheeses, *D. W. Stewart*. (Jour. Dairy Science, September, 1919.) [63.736.]
 Co-operative Dairying in Siberia, *C. W. Holman*. (Better Business, February, 1920.) [334(47).]
 A New Method of Testing Cheeses, *A. Geake*. (Jour. Agric. Sci., January, 1920.) [543.2; 63.73(04).]
 Investigation into Milk Yield of Ayrshire Cows, *J. F. Tocher*. (Trans. High. and Agric. Soc., Scotland, 1919.) [63.711(b).]
 The Casein Industry: Manufacturing Processes and Methods, *J. Pedersen*. (New Zealand Jour. Agric., December, 1919.) [63.727.]

Veterinary Science—

- The Ox Warble or Ox Bot Flies, *R. Stewart MacDougall*. (Trans. High. and Agric. Soc., Scotland, 1919.) [619.2(f).]

Birds, Poultry, and Bees—

- Egg Pulp and Cool Storage, *A. V. D. Rintoul*. (Jour. Dept. Agric., Victoria, November, 1919.) [63.742.]

Engineering—

- Rural Water Supply. ("Housing," 8th and 22nd December, 1919.) [628.7.]
 Land Drainage from the Administrative and Engineering Points of View, *E. M. Konstam* and *C. H. J. Clayton*. (Surv. Inst. Trans., Vol. LII., Part III., 1920.) [63.14(04).]
 Agricultural Tractors—IV., *R. N. Tweedy*. (Better Business, February, 1920.) [63.175.]

Economics—

- Co-operative Farming in Italy, *L. Smith-Gordon*. (Better Business, February, 1920.) [334(45).]
 Capital Required for Entry to Farms. (Scott. Jour. Agric., January, 1920.) [338.58.]

THE JOURNAL OF THE MINISTRY OF AGRICULTURE

Vol. XXVII. No. 2.

MAY, 1920.

NOTES.

THE month of April has played a prominent part in this year's agricultural history. Coming after two fine months,

in which farmers had gone well ahead with their work, the succession of wet and sunless days threw them, in many parts of the country, out of their stride. With the coming of May, large areas set aside for potatoes remained unplanted, fields prepared for oats and barley were left undrilled, while to make matters worse there has been a remarkable outburst of weed life, stimulated no doubt by the mild winter, the warmth of the land in the beginning of spring, and the subsequent heavy rains. Weeds have proved a serious factor, not only in the fields, where the cost of labour does not invite hoeing, but in the market gardens, where their presence among young seedlings compels an expenditure of effort that is needed badly in other directions. The question of the effect of rains upon fruit blossom is not yet settled. In all probability the early plums, damsons and open-air peaches and nectarines suffered little hurt, but a certain proportion of the later fruit will have failed to set.

Certainly the farmers' prospects at the end of April were not as good as they appeared to be at the end of March, even although a bountiful hay crop would appear to be assured.

FARMERS who have been unable to obtain delivery of basic slag are advised not to cancel their orders. Basic slag, applied

**Summer Application
of Basic Slag to
Pastures.**

at midsummer, may prove quite as effective as when applied in winter. There is a case on record where a summer application had results little short of marvellous.

In an experiment conducted over a considerable number of years, at Sevington in Hampshire, some ten different methods of manuring grass land were tried. Sheep were grazed on the different plots, and were weighed from time to time. One plot of 3 acres (Plot No. 2) had received 4 tons of lime per acre in 1901. On 13th June, 1907, it received 5 cwt. of basic slag, equal to 100 lb. of phosphoric acid per acre. Mr. Ashcroft, Steward of the Bath and West Agricultural Society, reporting on the experiment, says: "The application of 5 cwt. of basic slag to this plot on 13th June wrought a marvellous transformation. It is commonly said that basic slag requires time and plenty of rainfall before any effect can be seen, but by the August weighing, 8 weeks afterwards, the change in the appearance of the plot was quite evident, and all through the following two months perfectly remarkable; plenty of healthy-looking small clover herbage all over the plot. It was most interesting to observe how the sheep immediately bore witness to the improvement. On Plot 2 the increase of weight per sheep in the fourth month was 9.1 lb. No other plot approached that, not even where sheep were having cake, and the total increase for the fourth, fifth, and sixth months together was 17.6 lb., which again is higher than any other plot." In his report for the next season, the eighth, Mr. Ashcroft thus expresses himself: "As soon as ever any chance of growth came this spring, the plot became full of clover herbage which grew so luxuriantly that 10 sheep were increased to 12 at the weighing in May, and to 14 at the weighing 2nd July. The contrast between Plot 2 and all other plots, so deficient, comparatively speaking, in clovers and bottom herbage, was extraordinary, and perhaps all the more so in a season little favourable to growth. From being at the very bottom of all the manured plots, and very often lower than the untreated one, Plot 2 jumps at once to the top, and gives a total increase of 594 lb., a result which has never been obtained any season on any of the manured plots, and only exceeded by the sheep receiving 1 lb. of cake per day on Plot 1 in 1907 and 1908. In the third month the sheep on Plot 2 averaged an increase of 20.1 lb. per sheep, beating the sheep on Plot 1, getting a pound of cake, which averaged 18 lb. per sheep."

There are other advantages in summer applications—the land is then drier and carries the cart more easily, farm work is not very pressing, demand is less, and better delivery may be hoped for.

The higher the grade the less the cost of carriage, otherwise, provided equal weights of phosphate are applied, the lower grades, though not so quick acting, may be counted on to give as good, or nearly as good results in the end as the higher. It is generally believed that it is not well to turn pregnant stock on to newly-slaggerd land before rain has washed the slag off the herbage, and it is possibly better not to do so. Generally speaking, however, there is no fear of stock suffering from grazing newly-slaggerd land. As soon as the slag begins to take effect it will be found, in cases where pastures have only been slagged in parts, that the stock concentrate on the slagged portions, and consequently these look barer than the unslaggerd. This result, viewed apart from its cause, sometimes makes farmers needlessly doubtful as to the good effects of slagging.

Where it is impossible to obtain slag, an equivalent dressing of superphosphate and lime (1 ton per acre) should usually give as good results as the highest grade of slag. In rainy districts and on sour soils, ground mineral phosphate is practically as good as slag.

* * * * *

SINCE 1916, experiments on the growth of green crops, on arable land, for the feeding of dairy cows have been carried out in North Wales under the auspices of the University College of North Wales. Although these trials are still in the early stages, fairly definite information has already been secured with regard to the value of the soiling system under the conditions prevailing in this district.

Thus, it has been demonstrated that by sowing suitable mixtures of oats and peas or vetches, a succession of very useful green food can be secured in July and August to supplement the failing pastures, and to take the place of purchased cake and other feeding stuffs. If required, this period can be extended by autumn-sown oats and vetches which will, in most circumstances, be ready for cutting about the middle of June.

By selection of suitable varieties it will doubtless be possible to prolong the period in which green food of this kind is available into September, but for the greater part of that month it seems likely that other crops, such as white turnips or cabbages, will have to be relied on.

Rape, if sown later than about the middle of August, does not produce a crop which is of much use until the following spring, although if sown before that time a bulky crop, ready for use in November, may be expected. In North Wales comparatively heavy seeding appears to be necessary with oats, peas and vetches, but, on the other hand, light seedings of rape, kale and white turnips (sown broadcast) give heavier crops than heavy seedings. These crops also stand the winter better. For broadcast sowing, 6 lb. rape or kale and about 2 lb. white turnips per acre appear to be quite sufficient, provided that the tilth is satisfactory.

In the uncertain climate of the western district of North Wales, which often makes it impossible to get on to any but the driest land from the middle of October to the middle of March, it will probably be found impossible to develop in its entirety the soiling system worked out at the Harper Adams Agricultural College,* but a system of cropping which provides green food to supplement pasture after the end of June will be found of very great value on most dairy farms. Even allowing for the present cost of labour, the milk flow and condition of cows can be maintained more cheaply in this way than by the use of purchased cake. For instance, at the North Wales University College Farm it was estimated that the produce of about $3\frac{1}{2}$ acres took the place of about 7 tons of concentrated food, and, in view of the short pasturage available, probably maintained the flow of milk much better than the cake would have done. The cost of cultivating these crops is comparatively small, the most serious item being for labour in cutting and carting the green stuff. The possibility of securing two crops in the year adds to the advantage of the system.

The University College of North Wales has issued a detailed report on these experiments, which may be obtained from the Principal of the College at Bangor.

* * * * *

THE scarcity and high cost of grass and clover seeds at the present time renders it necessary for farmers to exercise the utmost care in the selection and use of their seed. This need becomes increasingly important in view of the part the temporary ley is likely to play in the immediate future in connection with the cultivation of land recently broken out

**Grass Seed Mixtures
and Temporary Leys.**

* See this *Journal*, March, 1920, p. 1159.

of grass. Farmers would be well advised, therefore, to give special attention to the question of the choice of their grass seed mixtures.

The formation of a sward results from the combined influence of the species sown and of those that spring up naturally. A temporary ley is almost entirely dependent for valuable species on the plants that are sown. On the other hand, a permanent pasture will, at least in its more mature stage, be almost wholly dependent on indigenous species, that is to say, on plants that come in naturally.

The commercial permanent grasses and clovers are very useful in the making of temporary leys, but they are chiefly valuable because, by their use, it is possible to tide over that difficult period in the life of every prepared field between the failure of the rye-grass and clovers and the establishment of an indigenous sward. When selecting seed, whether for temporary leys or permanent grass, local knowledge is of the highest importance, as a large number of the species generally recommended do not function in many localities.

In all cases of doubt the advice of the agricultural organiser (at the offices of the County Council) should be sought.

In planning seed mixtures it is only necessary to differentiate between (a) one-year leys, (b) two-year leys, and (c) leys for three or more years, including permanent grass. It does not follow that the mixtures necessary under the last of these heads should be very complicated or very expensive. Some simplification and cheapening is desirable, since it is practically essential to include wild white clover in a mixture, if the best results are to be obtained.

Even at its present price $\frac{1}{2}$ lb. per acre of wild white clover is well worth sowing, since not only does it contribute greatly to the formation of a close bottom and the health and vigour of the grasses associated with it, but it leads to marked enhancement of the soil fertility.

Cases are known where the corn crop following a three-year-old ley, in the formation of which a small quantity of wild white clover was used, benefited to the extent of 16 bush. of oats per acre as compared with leys in which no wild white clover was sown. If this experience were to become general the resulting benefit on the following corn crop would be equal to or even greater than that obtainable by the use of an average dressing of sulphate of ammonia.

Many farmers in suitable districts could quite easily grow their own supplies of wild white clover. All that is necessary

is to stimulate the plant on an acre or two of pasture by a liberal dressing of phosphate, and cut the crop when dead ripe, after which it should be threshed and roughly dressed.

A further point of interest in regard to wild white clover is that fallen seeds seem capable of lying dormant throughout a rotation and springing up when next the field is sown out to ley. In such circumstances, and provided the soil in the interval is sufficiently slagged, it would seem that subsequent sowing of wild white clover could be considerably curtailed or even omitted.

One-Year Leys.—It is difficult to suggest any improvement on the usual clover, or clover and rye-grass mixtures, where these succeed, but in cases of short rotation where "clover sickness" is prevalent, attention should be given to plants that for all practical purposes are immune from this disease, *e.g.*, white clover and trefoil. A mixture of these with ryegrasses should ensure a good plant.

Late-flowering red clover is less susceptible than broad red clover, and along with rye-grass should ensure a "stand" in all but the worst cases of clover-sick land; but if a sward of herbage plants is regarded as essential it would be best to sow down the field for two or three years, when white clover could advantageously form the clover basis of the mixture. In Essex very promising results have recently been obtained from lucerne mixed with a little wild white clover.

Two-Year Leys.—The following seeding, recommended for ordinary average soils, may be given as an example of a nucleus mixture for a two-year ley.—

	<i>Lb. per acre.</i>			
Perennial rye-grass	13
Cocksfoot	6
Timothy	3
Late-flowering red clover	1½
Broad red clover	2
Commercial white clover	1
Alsike clover	1

A suitable two-year mixture for grazing on land subject to clover sickness would be :—

	<i>Lb. per acre.</i>			
Perennial rye-grass	12—14
Crested dogstail	2
White clover	4—6

Three or more Years Ley.—The only important changes that need be made from the two-year mixture suggested are that $\frac{1}{2}$ lb. wild white clover may take the place of commercial white clover; or, alternatively, $\frac{1}{2}$ lb. of each may be used. In districts

of moderate or high rainfall, 1 to 2 lb. of rough-stalked meadow grass, and, in dry situations, 1 or 1½ lb. of crested dogstail, may be used in addition, to help in the formation of a close bottom.

In conclusion it may be pointed out that by the use of adequate and properly-balanced seed mixtures and the inclusion of wild white clover, a good sward can be obtained much more quickly and surely than was the case a generation ago.

* * * * *

EXPERIMENTS in co-operative dairying in recent years have demonstrated the value of this form of industry in adding to the success and profit of dairying operations. Scientific instruction in subjects connected with dairying is essential, however, for the best results to be obtained. At centres of co-operative dairying, co-operative cheese schools will prove a valuable auxiliary. Such schools should be established at a centre where the local milk producers will jointly undertake to observe the following conditions:—(1) to supply a fixed minimum quantity of, say, 200 gal. of milk per day, according to the local circumstances; (2) to accept payment for their milk on a strictly co-operative basis, calculated on the returns from the sale of cheese; (3) to appoint and place under the direction of the Head of the School, for so long as the school remains at that centre, some approved person as Manager. It should be a further provision that, in the event of a decision to make cheese co-operatively after the close of the school, the same person should be retained as Manager.

Where a County Education Authority undertakes to provide this practical form of teaching, it is usual for this body, during the period of the school, to supply the necessary apparatus and the services of an Instructor. The people of the district are accepted as daily pupils for the school after the manner of the ordinary migratory dairy schools. Persons who come from a distance may reside at or near the school for such period of instruction. The duration of a school at one centre should usually be about two months. It is, however, important that before a school is discontinued at any centre, the Education Authority should be satisfied that the people of the district have become thoroughly interested in cheese-making. The Authority will also satisfy itself that, in the event of a co-operative cheese factory being decided upon, the person who is to become Manager has become reasonably competent.

The Authority will also ascertain that all local difficulties have been overcome as far as possible and that the school has provided a thorough training in co-operation.

The Scheme, which has now been in operation some little time, has proved entirely satisfactory. The progress made is exemplified by the extent to which the Scheme has grown since it was first formed in 1916. In that year one school was established in Cornwall; in 1917, 9 co-operative schools were at work in Cornwall, Wiltshire, Herefordshire, Denbighshire, Carnarvon and Montgomery; in 1918, the number had risen to 18 schools carried on in Anglesey, Berkshire, Cheshire, Cornwall, Cumberland, Carnarvon, Denbighshire, Flintshire, Herefordshire, Montgomery and Wiltshire; in 1919, 15 schools were at work in Anglesey, Carmarthen, Carnarvon, Cheshire, Cornwall, Denbighshire, Flintshire, Montgomery and Pembroke. That the financial result was entirely satisfactory may be noted from the following figures. These are taken at random from the results of the working of 6 schools during 1918 and 1919. In 1918, 115,251 gal. of milk were made into cheese, for which the amount paid out to the suppliers of milk was £9,130 16s. 1d., or a fraction over 1s. 7d. per gal. In 1919, the total number of gal. of milk made into cheese was 118,789, for which the amount paid for milk was £11,024 5s., or a fraction over 1s. 10½d. per gal. It should be noted that, in addition to the price received for milk, some farmers took their whey for home use.

These returns compare most favourably with the average wholesale prices obtainable for milk during the corresponding periods, and demonstrate how greatly co-operative methods benefit the farmer. It must also be borne in mind that much of the milk thus profitably turned into cheese at co-operative schools was surplus, and would probably, under ordinary circumstances, not have commanded the full wholesale price.

As a result of the work of these schools 32 co-operative cheese-making societies have been definitely formed. Beginning in 1916 with 1 society, 10 more societies were formed in 1917, 10 more in 1918, and 11 more in 1919. A most encouraging instance of the success of the system here outlined occurred in a district where very little milk was produced previous to 1917. In that year a co-operative school was established, which resulted in the formation of a co-operative society. This society during 1917 dealt with 30,000 gal. of milk; in 1918, with 64,000 gal.; and in 1919 with no less than 108,000 gal. It is further claimed that these increases are entirely due to the keeping of additional cows and not to diversion of

supplies. It is also noteworthy that, notwithstanding the fact that this milk was sold either as milk or dairy products, stock-raising in the district prospered. Moreover, the increase in dairying in the district took place without any decrease in the quantity of other farm produce.

* * * * *

WHILE pigs can be kept successfully on poor and exposed land, the question of shelter from sun and cold is very important. With proper management and

**Open Air Shelters
for Pigs.**

a little ingenuity, adequate shelter can be provided at very small expenditure of

money and labour.

One method of constructing a cheap and effective shelter is to fasten four stout uprights into the ground at hurdle distance, each post forming the corner of a square. Inside and outside the posts hurdles are fastened on three sides, leaving a space the width of the post between each parallel pair. The fourth side of the square is left open and should face south. Straw is then packed between the double parallel hurdles, and similarly packed double hurdles are laid across the top to form a roof.

A second type of shelter is made by fastening wire netting both inside and outside the four stout uprights, and stuffing the intervening space with bracken. The roof may be made of faggots thatched with straw.

A third method is to use semi-circular corrugated iron for the shelter. It is essential that the pigs be supplied with plenty of dry bedding, a sufficient quantity of which will enable them to withstand considerable rigours of climate. The bedding may be of straw, dried bracken, grass or leaves. A shelter measuring roughly 8 ft. by 8 ft. will amply accommodate 12 pigs. In cases where one side is not left open, ventilation should be provided by an aperture 3 in. wide along the ridge of the structure. In this type, the entrance door might be made in two halves, the upper half being kept shut in cold weather and the lower one always open. In none of these types of shelters is a special flooring needed. It will not be necessary to make any arrangement for drainage, provided that the shelters are moved frequently to fresh ground. For pig keeping on high, exposed uplands it is advisable to use movable wood huts.

Farmers and others requiring hurdles, wire netting, corrugated iron and articles of this kind should communicate with the Officer in Charge of the Disposals Board in the area in which they reside. The addresses required are the following :—

Northern Area.—Quebec Chambers, Quebec Street, Leeds.

Southern Area.—27, High Street, Salisbury.

Eastern Area.—Room 104, Charing Cross Huts, London, W C.

Western Area.—(Now incorporated with Northern and Southern Areas.)

Purchasers might also consult *Surplus*, the organ of the Disposals Board. It is published on the 1st and 15th of each month, and can be obtained at any railway bookstall, or through any bookseller or stationer (price 3d.).

Where the minimum quantity sold of any article required is too large for individual requirements, farmers should co-operate in a joint purchase. This is already being done in a large number of cases.

* * * * *

THE Ministry has recently addressed to County Committees a memorandum containing suggestions as to methods which

**Instruction in
Poultry Keeping.**

should be followed to assist in the development of the poultry industry. The memorandum lays special stress upon the urgent need of systematic instruction by highly qualified lecturers. It is suggested that these lecturers should work in circuits at various county centres, giving, as far as possible, four lectures at each centre during each month, and that care should be taken to ensure that the instruction provided is suited to the needs of the particular district. In the more open agricultural areas lecturers should pay special attention to the problems of adapting poultry keeping to the regular routine business of the farm, so as to give the poultry full advantage of natural foods and waste ground, and let the soil receive the full benefit of the droppings from the poultry. Other more important questions for poultry keepers in such areas to consider are those connected with rearing and selling young stock.

In the more urban areas, lecturers would do well to train poultry keepers in the scientific maintenance of adult stock, and in methods of intensive and semi-intensive housing. Each circuit should have its own syllabus prepared in accordance with its local requirements. These should be drawn up by the Instructor and previously submitted for the Committee's approval. A model syllabus might include some or all the following subjects:—Capital outlay and probable returns; housing and laying out of plant; breeds and breeding; foods and method of feeding; hatching and rearing; winter egg production; prevention and treatment of disease; account keeping; marketing; management of labour; poultry keeping

combined with some form of agriculture or horticulture ; culling of stock.

For the first few years lectures by itinerant Instructors will probably serve the area or district adequately, but after this system has been well established and poultry keepers have obtained a firm grasp of general principles, it would be well to institute specialised courses of itinerant classes for limited numbers of pupils. These classes will afford more detailed instruction than can be given in short courses of public lectures. Classes should be held for at least two hours daily at each selected centre for not less than a fortnight or for more than a month. The time chosen can be either the evening or daytime, as may be most convenient. Should the attendance prove unsatisfactory, the class should be closed ; but it will be part of the duty of the Instructor to carry out recruiting by personal visits to poultry farmers near the centre for which the classes are proposed. These personal visits would stimulate interest and bring in pupils. The Instructor should be consulted by the Committee regarding the selection of centres and arrangement of classes, but all matters connected with advertising, the provision of local accommodation, fire, light and attendance, should invariably be undertaken by the Committee themselves.

In these itinerant classes practical work will play a prominent part. Pupils should take a personal share in such details of poultry keeping as egg-testing and grading ; packing eggs and poultry for transit ; killing, plucking and trussing poultry ; management of the incubator ; selection of birds by handling ; and account keeping. Lecturers are also advised to give instruction in easy carpentry, such as the making of simple appliances, chicken coops, feeding troughs, small poultry houses, egg boxes, crates and all the minor accessories of the poultry run. The Instructor should be equipped with an outfit including folding tables, trussing boards, egg boxes, coops, a small incubator and a small brooder, plucking baskets, dissecting instruments, simple carpentry tools and similar appliances, together with a supply of timber. During the course, should opportunities arise for the Instructor to conduct his pupils over neighbouring poultry farms, full advantage should be taken of this invaluable means of practical demonstration. Such visits will also lead to an instructive exchange of views. Beginners will thus be enabled to observe the methods of experienced poultry keepers, and will have before them practical illustrations of the subjects learnt in the classroom.

It is now generally recognised that education must play an important part in stimulating the use of improved machinery

**Education in the
Use of Agricultural
Machinery.**

in agriculture. In evidence given before the Departmental Committee on Agricultural Machinery this opinion was expressed by nearly all the witnesses. The raising of the standard of general education is likely to stimulate the interest and quicken the apprehension of all classes of workers in tasks other than dull routine ; and this in itself will lead to a better and more instructed use of agricultural machinery, and a broader outlook upon its possibilities. Beyond this, however, direct instruction in the principles and use of machinery is required by all classes of the agricultural community.

At present, some measure of instruction in agricultural engineering or allied subjects is provided at Agricultural Colleges and kindred Institutions, and by Local Authorities either through Farm Institutes or by means of extension lectures. The opinion of a number of well-qualified witnesses who appeared before the Committee was, however, that the present facilities were inadequate. It is urged that the subject of agricultural machinery should occupy a more prominent place in the curricula of Agricultural Colleges and Farm Institutes, and that in the case of the former there should be attached to the staff at least one specialist whose whole time would be devoted to the subject, and who would be available for instruction and advisory work. Further, there should be available at each Institution, besides the machinery and implements used on the farm, a well-equipped machinery workshop and an exhibition of the principal types of machines and implements on the market.

The facilities hitherto given have been available chiefly for those who would later farm on a fairly large scale or who would direct farming operations in some capacity or other. Less provision appears to have been made for the instruction of smaller farmers and of labourers in the principles and use of agricultural machinery, and the problem has probably been found to present greater difficulties. The Committee has come to the conclusion, after sounding the views of the witnesses best qualified to speak on this subject, that either within the continuation classes proposed under the new Education Act or outside them, some instruction in the principles of mechanics and in their practical application to agriculture might usefully be given to youths above the age of fourteen ; it is believed that in this way the interest of the man in his task would be

increased and that he would become a more intelligent and a more efficient worker. By means of short courses and extension lectures the needs of farmers and specialised workers who require more than a general knowledge of agricultural machinery could probably be met ; and the Committee recommends that Local Authorities should be encouraged to provide instruction in such subjects as tractor driving and mechanics, and the principle of the internal combustion engine.

It was suggested that short courses of instruction should be provided for farm workers in regard to particular machines, such as the tractor and binder, and one witness referred to a practice of Canadian firms to give free short courses in the use and repair of tractors. Courses on similar lines in this country, conducted by the Local Authority, might be difficult to organise, but the Committee believes that the experiment would be worth trying, and has little doubt that the co-operation of at least some firms might be counted upon.

One difficulty likely to be experienced in giving effect to these proposals would be the provision of efficient instructors, and in the first instance it would probably be impossible to obtain the services of a sufficient number of men with the combination of theoretical and workshop training which the Committee would regard as the ideal. The type of instructor to be aimed at is a combination of the engineer and the agriculturist ; instruction in engineering, including workshop practice, should form the basis of his training, and should be followed by instruction in agriculture. It is to be hoped that at a later stage the proposed Research Institute in Agricultural Machinery will be in a position to take some part, at least, in training of this character, although care must be exercised to prevent teaching from encroaching unduly on the research side of the Institute.

* * * * *

THE Valley of the River Lugg, an important tributary of the Wye, is one of the areas for which a drainage authority is in process of being established under the Land Drainage Act, 1918. There are within the valley about 25,000 acres of potentially cultivable land at present liable to injurious flooding, and, in addition to the areas which might come under the plough, from 6,000 to 8,000 acres of pasture, which are rendered foul and sour on account of flooding and waterlogging.

The photographs here shown may serve to indicate some of the more prominent causes of the deterioration of the lands,

and will certainly point to the necessity for such improvements in the main artery as a drainage board would be empowered to carry out.

The photographs are typical of the condition of a great number of rivers which "drain" large areas of agricultural land in all parts of the country.

The presence of a very serious obstruction (the Aqueduct) on the lower part of the River Lugg affords an instructive illustration of the necessity for the whole of a river being under the jurisdiction of a single authority—any substantial work carried out in the upper reaches would be wasted or harmful unless the water is given a clear run through the Aqueduct. Thus by the removal of the Aqueduct an immediate benefit would be conferred upon the whole of the upper parts of the valley as well as upon the land in the immediate neighbourhood of the Aqueduct itself

* * * * *

IN view of the continued rise in the cost of labour and building materials it is becoming increasingly important for County

Equipment of Small Holdings. Councils to effect every economy in the equipment of small holdings which they are providing in their areas for the settle-

ment of men on the land. There are a number of ways in which expenditure might be reduced and the settler yet enabled to acquire those buildings of which he stands in immediate need, if he is to enter into early possession of his small holding. These were recently outlined in a circular letter addressed by the Ministry to County Councils in England and Wales, and in view of the urgent need for national economy, they should receive careful consideration at the hands of all interested

While it is not proposed that the minimum standards laid down for cottages should be further reduced, the minimum scale of sizes must be adhered to. The fittings should be as inexpensive as is consistent with durability.

With regard to farm buildings, the Ministry is of opinion that a considerable reduction can be effected without loss to the efficiency of the holdings. Present working requirements need alone be considered, and if these are provided for the possible requirements of future development may be left over until a fall in prices renders it economically possible to undertake them. Equipment should be restricted to the bare limit necessary to meet immediate needs. Reduction of cost can sometimes be secured by constructing the foundations only of brick, stone or concrete, the material varying with the locality. For the superstructure, home-grown timber covered with elm or deal



FIG. 1 —River Lugg above the junction of the Lugg and Arrow



FIG. 2 —River Arrow, near Broadwood Bridge



FIG. 3.—River Arrow, below Broadwood Bridge



FIG. 4.—River Arrow, below Broadwood Bridge.



FIG. 5—River Arrow, near its junction with the Lugg



FIG. 6—River Arrow, near its junction with the Lugg.



FIG. 7 River Lugg, (lower portion) above the Aqueduct curving a detour and over the river



FIG. 8 River Lugg (lower portion) below the Aqueduct

weather boarding, the latter preferably creosoted under pressure, is one method which will be found to answer satisfactorily. The roofs may be covered with asbestos, poillite or similar materials, and care should be taken to use only fittings of the simplest design and construction. Adapted army huts, it is true, may in some places prove the cheapest form of farm building obtainable, but a concrete floor must be provided where necessary, and in any case these huts must be placed on a solid base with timbers at least 18 in. above the ground level. On many holdings which do not exceed 10 acres, it is quite enough to provide a rectangular building containing two loose boxes, each about 9 ft. by 13 ft., together with a store shed, 10 ft. by 13 ft. and a loft over all. The tenants will find that this gives sufficient accommodation for their immediate needs. It has often been suggested that if the settlers were supplied with timber at cost price, they would be able themselves to erect smaller buildings such as pigsties and hen-houses. Small Holdings Committees will be the best judges of the ability of applicants to carry out such work for themselves.

The Ministry hopes that Small Holdings Committees will make the maximum use of any equipment which may exist on properties acquired for small holdings. In the present circumstances, it will almost always be found to be more economical to repair old sheds, cow-houses, etc., rather than to erect new buildings.

The Ministry fully appreciates the pride Small Holdings Committees take in equipping their estates in the counties in a model way, and regrets the necessity for pressing on Small Holdings Committees such limitations as those just outlined. There is, however, no other way to meet the present abnormal cost of building which shows no prospect of early reduction, but rather a continual upward tendency. With these facts in view, Committees cannot fail to recognise that the urgent claims of national economy make it of the first importance that the land settlement policy of the Government should be administered with due regard to the minimum capital expenditure

* * * * *

EXPERIMENTS have been carried out in recent years in North Wales to ascertain the best method of eradicating bracken from hill land. The results of the experiments are stated in a recent publication of the University College of North Wales, Department of Agriculture.

Eradication of Bracken.

It has been shown that manuring alone has had no beneficial

effect in the eradication of bracken, but that when combined with regular cuttings of the plant a great improvement has been obtained. The most certain method of dealing with the pest appears to be regular and careful cutting at monthly intervals, commencing in the first week in June, and continuing in the first week of July, August, and September. In this way it has been found that in a few years bracken, even of the strongest growth, will have completely disappeared. Such repeated cuttings, even if not commenced until the beginning of July, have a very great effect. Where this method cannot be carried out the best plan is to cut the bracken each year as soon as it has reached full growth, usually from the beginning to the middle of July. This method, however, will not ensure such complete eradication, or this cannot, at least, be effected until after a longer period. Cutting in August and September has very little effect in most cases unless earlier cuttings have been made.

Unless cutting is commenced at the beginning of June and continued regularly it is very desirable that the bracken should be removed as soon as the cutting has been performed, as, if left to lie on the ground, the rotting bracken greatly hinders the formation of a firm grazing turf.

* * * * *

DURING the War the export of cattle, sheep and pigs for breeding purposes was restricted to pedigree animals destined for allied and some neutral countries. A licence to export was necessary, but this, practically speaking, did not influence the numbers which left the United Kingdom, although the difficulty in obtaining shipping, high freights and extra risks, doubtless limited the number exported. After the Armistice these restrictions were removed, non-pedigree as well as pedigree animals being allowed to go to allied countries.

Export of British Live Stock.

Prior to the War the bulk of the live stock exported (apart from horses) went to America—mainly the United States and Argentina—the majority being pedigree animals. In 1913 nearly two-thirds of the cattle and sheep exported were sent across the Atlantic. In 1919, however, the numbers exported to America were less than in the previous five years.

On the other hand, a new trade in non-pedigree animals to Europe arose in 1919, the exports consisting largely of gifts to Belgium, France, and Serbia, purchased through the "Relief of the Allies" fund; and the European Continent would probably have sought to purchase many more dairy animals but

for the adverse rate of exchange and shipping difficulties. In spite of this, however, the European demand is the chief feature of the 1919 trade, the three countries named taking no less than 2,740, or nearly half of the 5,855 cattle exported; while Belgium and France had 3,709 out of a total of 8,593 sheep. Though the number of cattle and sheep exported is thus greater than in 1913, it is probable that there were fewer pedigree animals included amongst them.

The restrictions on the export of non-pedigree animals similarly stopped the trade in old low-priced horses to Belgium and Holland. In 1919 about three-fifths of the exports went to these two countries (5,724 out of 9,057), whereas in 1913 the figure amounted to just 53,775 out of 68,632, or three-quarters of the total. Many of the animals sent to Belgium last year were no doubt bought for re-stocking, but their average value, just under £70 a head in the case of both these countries, is so much below the average to France (£240 per head) or to the rest of the world (£175) as to indicate that they included a certain proportion of aged horses.

* * * * *

RETURNS received by the Ministry of Food disclose a very heavy demand for sugar for domestic fruit preserving, and in view of the limited quantity of sugar available, it will only be possible to meet the demand to a limited extent.

**Sugar for Fruit
Preserving.**

The basis of allotment will be as follows :—

(a) In all cases 2 lb. per head in respect of each member of the applicant's household registered for sugar.

(b) In those cases only where the applicants desire to preserve fruit grown by themselves an additional allotment of 1 lb. of sugar for every 8 lb. of home-grown fruit available for preservation.

Where retailers' customers fail to take up the sugar allotted to them, it can be re-allotted, at the Committee's discretion, either to persons whose applications were late, or to those of the retailers' customers who find that they have more home-grown fruit for preserving than could be dealt with by their original allotment.

Special supplies of sugar for jam making during the coming season will be available for greengrocers, fruit growers, and others who during the year ended 31st December, 1915, manufactured jam in small quantities for retail sale.

Some dissatisfaction has been expressed at the price of 1s. 2d. per lb. fixed for sugar for domestic preserving. For some time past the world price of sugar has been so high that only by purchases made long in advance has the Sugar Commission been able to issue sugar for ordinary domestic consumption to be retailed until recently at the low price of 8d. per lb. Even the present price of 10d. per lb. can be continued only while the supplies purchased before the rise in the world's price remain available. The issue of sugar for domestic preserving at any price lower than an "economic" selling price would, unless world prices fall in the meantime, bring nearer the time when the price of sugar for the domestic ration will again have to be raised. This would be unfair to the large number of people who either do not desire to make jam, or who have no facilities for doing so in their own homes, and who consequently have to purchase their jam at manufacturers' prices. The price of 1s. 2d. per lb. is the retail equivalent of the wholesale price charged to jam manufacturers, and it would be manifestly unfair if sugar were supplied for private jam making at an artificially low price. (*National Food Journal*, 14th April, 1920.)

* * * * *

AN official account of the administrative expenses of the Ministry of Food for the financial year ended 31st March, 1919, is published in the issue of the *National Food Journal* for the 14th April, and contains matter which should be of special interest to farmers.

Cost of Control of Food Supplies.

It is stated that the purchase and re-sale of food stuffs through official channels were undertaken in order to break down the holding-up of produce by those traders who would not consent to sell at a reasonable margin of profit. The close control of distribution to the consumer by compulsory rationing is a very costly venture, and is justified only in grave emergencies such as the nation has recently encountered.

The heaviest portion of the cost has been absorbed in rationing a community of 40,000,000, or about 10,000,000 households, an average cost of 8s. 6d. per household for a whole year. Those whose misfortune it was to endure the misery and discomfort of the queues in the winter of 1917-18 will be the last to complain of a levy of 2d. a week to ensure fair and equitable distribution of the necessities of life.

THE desirability of reimposing the requirements of the Lights (Driving of Animals) Order, 1916,* which was revoked in August last, has recently been considered by a Committee appointed by the Ministry of Transport to consider questions relating to the lights carried on vehicles.†

Lights when Driving Animals at Night.

The Order in question was made in October, 1916, and required that persons driving or leading animals after dusk should carry a lamp capable of showing a white light both to the front and rear.

While the requirement that a light or lights must be carried with *all* animals on the road at night would no doubt conduce to the safety of driven animals and of motor traffic, the Committee does not consider that it would be practically possible to secure that lights should be carried with all animals upon the highway, owing to the fact that the roads, particularly where they pass through unenclosed and common land, cannot be kept clear of stray animals. Moreover, a requirement that a light is to be carried whenever an animal is driven on a lane or unimportant by-road used almost exclusively by local inhabitants would entail considerable hardship and expense on the agricultural community, without adding materially to the safety of the public.

For these reasons the Committee does not recommend the immediate reimposition of the requirements of the Lights (Driving of Animals) Order, 1916, but is of opinion that the adoption of those requirements on the principal roads of the country should be further considered when such roads have been classified and marked as such.

* * * * *

On p. 193 are mentioned the proposed new duties on agricultural tractors and locomotives. The proposals are based upon the recommendations of the Departmental Committee on Taxation and Regulation of Road Vehicles. While the recommendations of that Committee and the proposals of the Chancellor of the Exchequer in regard to motor cars have given rise to acute controversy, there has been little criticism of the new duties on agricultural vehicles. As soon as legislative effect is given to the proposals there should be removed the difficulties and obscurities which have, during the last few years, enveloped the taxation of farm tractors, and local taxation authorities and owners should no longer be troubled over the weight of ploughing engines.

* See this *Journal*, November, 1916, p. 799.

† Cmd. 659, 1920. London: H.M. Stationery Office, 2d. net.

Manuring for Mangolds.—The mangold is one of the most important crops on the farm and one of the most responsive to manuring. The Rothamsted experi-

**Notes on Manures
for June:**

*From the Rothamsted
Experimental Station.*

ments show that it tolerates a higher degree of intensive treatment than any other farm crop, and experience shows that the yield may vary according to treatment from 15 to over 90 tons per acre.

The basis of manuring for mangolds is farmyard manure; this will have been put on in the autumn—always the best plan in the southern parts of England, where mangolds are most commonly grown. In addition, phosphates are necessary to secure adequate root development, and, as many experiments have shown, potash is needed to facilitate the production of sugar. Both phosphates and potash are put into drills. Salt is also necessary—mangolds being originally seaside plants; and finally a liberal allowance of nitrogenous fertiliser should be given, the amount varying with the yield which may be expected. A suitable general dressing was given last month.

It is a mistake to suppose that nitrogenous fertilisers lower the feeding value of the mangold. They of course do harm if wrongly used, but, as a rule, this happens only when insufficient amounts of potash and salt have been applied.

Many experiments have shown that nitrate of soda and nitrate of lime are valuable top dressings, in some cases more effective than sulphate of ammonia. On two soils experiments made by the Midland Agricultural College* (1915) showed the following results:—

				<i>Light Soil.</i>	<i>Heavy Clay</i>
				<i>Tons cwt.</i>	<i>Loam.</i>
No top dressing	..	..	..	20 10	25 18½
Nitrate of soda	..	..	..	29 8½	30 14
Nitrate of lime	..	..	..	28 8	30 4½

In Gloucestershire the results were:—

						<i>(Cirencester.)†</i>
						<i>Calcareous</i>
				<i>1909.</i>	<i>1910.†</i>	<i>Soil.</i>
				<i>Tons cwt.</i>	<i>Tons cwt.</i>	<i>Tons cwt.</i>
No top dressing	..	..	..	23 14	28 0	21 19
Nitrate of soda	..	..	..	29 14	32 4	25 11
Nitrate of lime	..	..	..	32 5	30 3	25 11
Sulphate of ammonia	..	..	..	—	30 9	26 1
Nitrolim	..	..	..	30 6	19 15	25 18

* *Midland Agric. Coll. Field Trials*, 1915, p. 51.

† *Glos. Repts.*, 1909 and 1910, p. 74, Table I.

‡ *Royal Agric. Coll. Repts.*, Cirencester, 1910, p. 31.

Experiments at the Harper Adams Agricultural College (1910) and at Reading (1907-1909) gave the following yields:—

				Harper Adams.*		Reading.†	
				Loam.		Strong Loam.	
				Tons cwt.		Tons cwt.	
				1909.			
No nitrogen	..	30	19	28	13	28	3
Nitrate of Soda	.. (a)	33	18	32	8	34	18
Nitrate of lime	.. (b)	40	1	36	17	35	1
Sulphate of ammonia	(a)	36	15	—		33	1
Nitrolim	.. (b)	40	19	—		33	3

(a) = 1 cwt. per acre. (b) = 2 cwt. per acre.

The Manuring of Sugar Beet.—The following has been found satisfactory:—

In Autumn or not later than early Spring—10 to 15 loads of farmyard manure if necessary; a dressing of lime during winter.

In Spring—3 to 4 cwt. superphosphate, or 4 to 5 cwt. basic slag; $\frac{1}{2}$ to 1 cwt. sulphate of potash, or 2 to 4 cwt. kainit; 1 to 1 $\frac{1}{2}$ cwt. sulphate of ammonia.

After Singling— $\frac{1}{2}$ to 1 cwt. nitrate of soda as top dressing.

Sugar beet should be grown on the flat and not on ridges.

Two important points arise in connection with the manuring of potatoes; the choice of the potassic fertilisers and of the most suitable nitrogenous manure.

It is often supposed that muriate of potash is inferior to sulphate of potash, but the evidence is not very definite. The question formerly possessed little economic interest, because both salts were supplied from the Stassfurt mines and they were both controlled by the same syndicate. It now assumes much greater importance, since muriate of potash comes from Alsace, while sulphate of potash comes from Stassfurt in Germany. More experiments are likely to be made in the near future on the relative effectiveness of these two substances.

There is considerable evidence to show that sulphate of ammonia is distinctly better than other nitrogenous fertilisers for potatoes. The following are some of the experimental results:—

* Harper Adams Agric. Coll. Rept., 1910, p. 33.

† Reading Univ. Coll. Dept. Agric., 1909, Bull. VII., p. 11.

	Woburn, 1909. Sandy Loam.*	Devon. Light Soil.†	Jersey. (Five Centres.)‡	Aberdeen. (Various Centres.) 1907-9.§
	Tons cwt.	Tons cwt.	lb. per perch.	Tons cwt.
No Nitrogen	14 12	9 18	195	8 6
Sulphate of Ammonia ..	15 19	12 0	228	9 12
Nitrolim	15 7	12 0	232	8 17
Nitrate of soda	15 9	10 15	221	9 5
Nitrate of lime	15 6	10 7	228	9 6

The Use of Liquid Manure on Seeds Lay.—After the first cut of hay, dairy farmers and others having liquid manure may obtain excellent results by giving a good application of this substance—about 1,500 gal. to the acre.

N.B.—The Notes on Manures will not be published in the June issue of the *Journal*.

* * * * *

It is satisfactory to note that the downward trend of prices of feeding stuffs continues. Table I. shows the approximate

**Notes on Feeding
Stuffs for June:**

*From the
Animal Nutrition
Institute, Cambridge
University.*

cost per food unit of a number of common feeding stuffs as calculated from the prices which are now included in the Weekly Return of Market Prices issued by the Ministry of Agriculture. Comparison of this table with the similar table given last month shows that in nearly all cases costs per food unit have fallen. This fall in prices has been considerable in the cases of palm kernel cake, coconut cake, dried grains, malt culms, cotton cake, beans, barley, some kinds of foreign oats and peas. It is also satisfactory to note that supplies appear to be adequate, especially as the demand will probably decrease as the season advances and grain becomes plentiful.

Dairy Cows.—In the cases of dairy cows it will usually be necessary to supply cake only to those cows which show signs of scouring when first turned out on the very watery grass which has resulted from the recent continuous wet weather. For this purpose it is advisable to give about 2 lb. per head per day of cotton cake, although this cake at present prices costs about twice as much per food unit as palm kernel cake.

* *Jour. Roy. Agric. Soc.*, 1909, p. 385.

† *Devon County Council Rept.*, 1907-9, p. 6.

‡ *State of Jersey Field Expts.*, 1911, p. 12.

§ *Aberdeen and N. Scotland Coll.*, Leaflet 9, p. 2.

Palm kernel cake is the cheapest concentrated food on the market at present, but although an excellent food for most

TABLE I.—*Costs per Food Unit.*

				s.	d.	s.	d.
Palm kernel cake .. .. .	..	..	..	1	9	—	—
Brewers' grains (wet) .. .. .	..	..	..	1	11	—	—
Palm kernel meal .. .. .	..	..	..	2	1	—	—
Coconut cake .. .. .	..	..	..	2	5	—	—
Ground-nut cake—							
Decorticated .. .. .	..	..	..	2	10	—	—
Undecorticated .. .. .	..	..	..	2	10	—	—
Dried grains, distillers' .. .. .	..	..	..	2	10	—	—
" brewers' .. .. .	..	..	..	2	9	—	3 1
Wheat sharps .. .. .	..	..	..	3	0	—	—
" middlings .. .. .	..	..	..	3	0	—	—
" bran .. .. .	..	..	..	3	10	—	—
Malt culms .. .. .	..	..	..	3	0	—	—
Cotton cake, decorticated .. .. .	..	..	..	3	7	—	—
" meal .. .. .	..	..	..	3	3	—	3 7
" cake, English made .. .. .	..	..	..	3	6	—	3 9
" " Egyptian .. .. .	..	..	..	3	7	—	4 0
Beans, Chinese .. .. .	..	..	..	3	6	—	—
" English .. .. .	..	..	..	4	1	—	4 6
Linseed cake .. .. .	..	..	..	4	2	—	4 4
Maize, Argentine .. .. .	..	..	..	3	8	—	4 4
" American .. .. .	..	..	..	4	9	—	—
" meal .. .. .	..	..	..	4	9	—	5 0
Barley, English feeding .. .. .	..	..	..	4	7	—	5 4
Oats, English .. .. .	..	..	..	5	4	—	5 7
" foreign .. .. .	..	..	..	4	6	—	5 4
Peas, various .. .. .	..	..	..	4	1	—	6 0

purposes it does not possess the astringent properties of cotton cake which make the latter so valuable for correcting the scouring tendency of watery grass or roots. As a rule it is only necessary to continue the cotton cake ration for quite a short time. It may safely be discontinued as soon as the cows have become accustomed to the grass.

On the general question of the use of concentrated feeding stuffs for dairy cows on grass, readers are advised to refer to a paper in this *Journal* for April, 1918, p. 11. In this paper are described experiments which show quite conclusively that in normal seasons it is unprofitable to use concentrated food for dairy cows in the early months of the grazing season, until in fact the latter half of July, when the grass may begin to fail in quantity and quality.

For dairy cows kept under town or suburban conditions, where grass is not available, the ration should at present prices include a large proportion of palm kernel cake. Other suitable

concentrates for this purpose are coconut cake, ground-nut cake and millers' offals.

Sheep.—Palm kernel cake will also be found useful and economical for sheep, and for this purpose it may be mixed with ground-nut cake and dried grains, which have fallen considerably in price since last month.

Horses.—For horses oats are still extremely expensive, costing about 5s. per food unit. Oats may be replaced economically by one or other or a mixture of the following concentrates—maize or beans at about 4s. per food unit; bran at about 3s. 10d.; sharps at about 3s.; dried grains at about 3s. Palm kernel cake at about 1s. 9d. may also be used, but of this latter the writer has no personal experience. It is, however, so much cheaper than anything else that it is certainly worth a trial.

The most common cause of trouble in substituting other concentrates for oats is the lack of knowledge of the quantity of other foods equivalent to 1 lb. of oats. For instance, 1 lb. of oats is equivalent to $1\frac{1}{4}$ lb. of bran. Usually when bran is used to replace oats the replacement is made weight for weight, and the horses are consequently underfed. With maize the mistake is in the opposite direction—1 lb. of oats is equivalent in food value to $\frac{3}{4}$ lb. maize. If 1 lb. of maize is substituted for 1 lb. of oats, the horses are overfed. They become fat and often develop trouble in their feet.

Of the foods quoted above the following quantities are required to replace 1 lb. of oats:—Maize, $\frac{3}{4}$ lb.; beans, 14 oz.; bran, $1\frac{1}{4}$ lb.; sharps, 14 oz.; dried grains, $1\frac{1}{4}$ lb.; palm kernel cake, $\frac{3}{4}$ lb. If substitution is made in these proportions, and the mixture is so arranged as to be palatable to the horses, trouble is not likely to occur. The following instance will illustrate the method:—

To replace 12 lb. oats, costing at present prices 2s. 2d.—

4 lb. oats	=	4 lb. oats	cost 8 $\frac{1}{2}$ d.
2 x $1\frac{1}{4}$ lb. bran ..	=	2 $\frac{1}{2}$ lb. bran	„ 3 $\frac{1}{2}$
2 x 14 oz. sharps ..	=	1 $\frac{1}{2}$ „ sharps	„ 2 $\frac{1}{2}$
2 x $\frac{3}{4}$ lb. palm cake ..	=	1 $\frac{3}{4}$ „ palm cake kernel ..	„ 1 $\frac{3}{4}$
2 x $\frac{3}{4}$ lb. maize	=	1 $\frac{1}{2}$ „ maize	„ 3 $\frac{1}{2}$

12 lb. oats = 11 $\frac{1}{4}$ „ mixture.. cost 1s. 7 $\frac{1}{2}$

A mixture of this kind will maintain horses at work satisfactorily and will cost only 1s. 7 $\frac{1}{2}$ d. for a full day's ration, instead of 2s. 2d. if the ration were entirely composed of oats.

TABLE II.—*Feeding Value of Common Feeding Stuffs.*

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Name of Feeding Stuff.	Nutritive Ratio.	Per cent. digestible.			Digestible Food Units per ton.	Starch equiv. per 100 lb.	Linseed Cake equiv. per 100 lb.
		Protein.	Fat.	Carbo-hydrates and Fibre.			
<i>Foods Rich in both Protein and Oil or Fat.</i>							
Ground nut cake ..	1:0.9	42.0	6.8	20.2	133	73	99
Soya bean cake ..	1:1.1	38.2	6.4	23.6	126	69	93
Decort. cotton cake ..	1:1.2	34.6	9.3	19.4	120	71	95
Linseed cake, Indian ..	1:2.0	27.8	9.1	30.1	115	74	101
Linseed cake, English ..	1:2.2	25.3	8.7	33.0	111	74	100
Cotton cake, Egyptian ..	1:2.0	17.6	5.1	22.0	74	42	56
Cotton cake, Bombay ..	1:2.3	15.6	4.5	23.3	69	40	54
Distillers' grains ..	1:2.9	19.6	10.2	30.1	99	57	77
Maize gluten feed ..	1:3.1	20.0	2.7	51.8	104	76	102
Brewers' grains, dried ..	1:3.8	13.0	5.6	34.9	77	48	65
Coconut cake ..	1:4.0	16.2	2.6	41.4	100	79	107
Palm kernel cake ..	1:3.7	17.1	6.8	43.6	98	75	101
Linseed ..	1:5.5	19.4	34.7	20.1	144	119	161
Bombay cotton seed ..	1:6.2	12.3	16.8	30.2	97	74	100
<i>Fairly Rich in Protein, Rich in Oil.</i>							
Maize germ meal ..	1:7.6	0.4	12.8	48.3	102	85	115
Rice meal ..	1:10.2	7.5	11.6	40.6	84	72	97
<i>Rich in Protein, Poor in Oil.</i>							
Fish meal ..	1:0.2	50.0	4.2	—	125	53	71
Peas, Calcutta white ..	1:2.1	23.3	1.1	45.9	97	70	94
Beans, English ..	1:2.6	20.1	1.2	48.2	97	66	89
Beans, Chinese ..	1:2.6	19.6	1.7	47.9	101	67	91
Peas, English maple ..	1:3.2	19.4	1.0	52.4	99	69	93
Palm-nut meal (ex-tracted) ..	1:3.5	17.1	1.9	51.5	95	71	96
Brewers' grains, wet ..	1:3.3	5.5	2.4	11.5	30	18	25
Malt culms ..	1:3.9	19.9	1.5	43.6	88	43	59
<i>Cereals, Rich in Starch, not Rich in Protein or Oil.</i>							
Barley, feeding ..	1:11.4	6.5	1.2	64.7	82	71	96
Oats, English ..	1:7.9	8.0	4.0	47.4	75	59	80
Oats, Argentine ..	1:7.9	8.0	4.0	47.4	75	59	80
Maize, American ..	1:11.5	7.1	4.5	65.8	92	81	110
Maize, Argentine ..	1:11.3	7.1	4.5	65.8	92	81	110
Maize meal ..	1:14.6	5.5	3.5	64.8	85	78	105
Wheat middlings ..	1:4.6	13.2	3.0	53.8	91	72	97
Wheat sharps ..	1:4.4	13.8	4.3	50.5	92	64	86
Wheat pollards ..	1:5.2	11.6	4.0	51.6	87	60	81
Wheat bran ..	1:4.5	10.6	2.8	40.8	72	45	61
Wheat bran, broad ..	1:4.5	10.6	2.8	40.8	72	45	61
Locust bean meal ..	1:22.1	4.0	0.7	69.2	80	71	96

Figs.—On the subject of pig feeding, readers are advised to refer to three papers in this *Journal* for October, 1917, p. 721; November, 1917, p. 826; and April, 1918, p. 21. In these papers Messrs. Mackenzie and Fleming give their experience of feeding sows, piglings and hogs on roots, grass, potatoes and other succulent foods, their ration of concentrates consisting largely of palm kernel cake. At present prices the information contained in these papers is very much to the point.

N.B.—The Notes on Feeding Stuffs will not be published in the June issue of the *Journal*.

FARMING ON BRECK-LAND IN NORFOLK.

S. L. BENSUSAN.

EAST ANGLIA holds some 200,000 acres of what is known in Norfolk as breck-land, Norfolk's own contribution being some 80,000 acres or thereabout. It is part of the lightest soil in the country, and commanded in pre-war times a merely nominal rent—five, six or seven shillings per acre being deemed sufficient for soil that could apparently raise little more than gorse, bracken and rabbits. Men hired, but made little or no attempt to farm it. Their rent and rates were covered by the shooting rights, for, in addition to providing rabbits as the sand upon the sea shore for multitude, there were very many hares and a fairly good head of partridges. The writer remembers taking part in a hare drive on Suffolk breck land a few years ago, when in the course of one day 585 hares fell to 12 guns. There could be little incentive to farm land that, if it could grow a crop, would be likely to yield it when young and green to thousands of hungry intruders.

One of the chief owners of this breck-land in Norfolk is the Duchy of Lancaster, and in 1914, a few months before the War, the Development Commission took over some 200 acres from the Duchy and started to reclaim it, thereby adding not only to the fertility of England as a whole but to the amusement of the East Anglian farmers as a class. Though the outlay on reclamation was no more than £5 an acre, it came near to doubling the cost of the land. The whole question then remaining to be solved was whether scientific farming, applied to a seemingly hopeless proposition, could result in anything better than a heavy loss.

It is not necessary to be a practical farmer to realise that the breck-land, of which the Ministry of Agriculture's Experimental Farm at Methwold in Norfolk consists, is the poorest of the poor. It absorbs instantly whatever moisture is forthcoming, and if an hour after a heavy shower you kick the soil it protests in a little shower of sand. To make the farming proposition still less productive a spring drought has often to be expected; some of the land bakes very readily, there are many hot patches, and in places the plough limit is not more than seven to eight inches. It is not surprising in these circumstances that land like Methwold has been left lightly farmed for so long, or that its potentialities have not been realised. Yet even before the War it was recognised that no good purpose can

be served by surrendering land to hares and rabbits, bracken and gorse. Even if the peace of the world had not been broken the experiment at Methwold would still have been carried through, though the need for it would not have been as urgent as it was destined to become.

The first effort at improvement was to apply chalk very liberally; the application being 7 tons to the acre. A heavy initial dressing of basic slag and potash salts was also applied, and for each subsequent crop some artificial fertiliser was used. Potash is the "missing word" on this kind of soil; without potash no remunerative crops can be grown. While it was found that crops were nowhere heavy, the cost of production was nowhere high, because after the first reclamation the land became very easy to work. The price of wheat cultivation per acre is probably the lowest in England. Steam cultivators were used for reclamation. They were followed by motor tractors and horses. After that it was found that the motor plough could cover as much as 4 acres in a day, and that owing to the lightness of the soil it is possible for horses to work on the land for an average of more than 220 days in the year.

The difficulties have not arisen altogether from the nature of the soil. The increase of wages from 16s. in 1914 to £2 2s. 6d. in April, 1920, presents a serious problem enough, and this advance in cost of production has not been associated with a corresponding increase in efficiency. The reverse is the case. The young men, at least, are quick to leave the fields if there is a local fair or an entertainment a few miles away from their work, and they turn with distinct aversion from overtime. In spite of all the difficulties, it is clear that we have in the breck-lands a fair farming proposition, though whether it can be maintained in the face of rising wages and falling output of work done is a question that only time can solve. Down to the present, upwards of $3\frac{1}{2}$ coombs of wheat have been the average yield per acre. Potatoes yield nearly 4 tons, or as much as is obtained on some of the heavy clay lands in Essex. Blue peas (Harrison's Glory) yield an average of $4\frac{1}{2}$ sacks to the acre, while as many as 10 tons of eating carrots have been sold off one acre, leaving a residue of the inferior kind to be fed to stock. Bullocks appear to thrive on a mixture of these unmarketable residues mixed with chaff. The yield of mangolds, 10 to 12 tons per acre, is admittedly poor, but breck-land is not mangold land and the crop is only sown to meet the necessities of the stock-yard, and may be abandoned altogether on account of the cost of labour. White turnips do extremely

well and the sheep folded on them thrive. One-year leys are successful and lucerne will last between 4 and 5 years.

The success of the experiment on 200 acres, in the face of difficulties that might well have seemed overwhelming, and in the face of tradition that might well have appeared inviolable, led the Ministry in October of last year to purchase a further 1,300 acres of land, owned also by the Duchy of Lancaster, and rather worse, if possible, than the first lot. It is part of what was formerly a large single estate, but the land has been allowed to run out; the hedges are overgrown and practically worthless; the soil is deficient in potash, and before attempting to sow corn it has been found necessary to grow green crops and fold sheep on them. Yet even with this unpromising land there is ample material for experiment and not a little prospect of success. For example, it was realised at once that here was soil suitable for experiments in open-air pig keeping. There is nothing to fear from excess of moisture; there are plantations of larch and pine together with great expanses of bracken, so that all the material for rough shelters and bedding is to hand. In a little while the houses will be set up and the pigs will be taking their chance.

Another side-line is tobacco, to which 10 acres have been allotted for the present year, with a further 20 to follow in 1921. For the preparation of tobacco it is necessary to raise the seed in frames heated by hot water pipes. This work is done in March, and the plants are set out in the open in May, but as frames were not available in time on the Methwold farm, the seed has been raised at Brandon, and is being planted out from there. Already drying-sheds and rehandling houses are in building and will be finished in time for this year's crop.

A further experiment for which preparations are now being made is arable dairy farming on the method originated at the Harper Adams College, Newport, Shropshire. It is hoped to start the dairy during the summer.

Yet another undertaking, which should be in operation by the time these lines are printed, is the poultry farm for disabled ex-soldiers, a feature of the Ministry's farm settlements. Buildings were already erected in April, the incubators were installed and the instructor was in charge. It is proposed to give the men who go to this branch of the Methwold establishment a year's training, to include some horticultural work, as the advisability of adding something to poultry farming as a means of livelihood has been very properly recognised.

Stock appears to do well. Lincoln Red cattle may be seen in good condition in the yards. The Large White pig has been chosen and apparently justifies the choice, and the best sheep on the farm are a cross between Suffolk ewes and Cotswold rams.

The Methwold Experimental Farm may claim to be considerably more than a venture that promises to return interest upon capital, and to afford a considerable measure of useful employment. It is a practical demonstration of the abundant possibilities possessed by a corner of England that has long lain derelict and has been regarded as a proposition that will never repay high farming. Evidence is already forthcoming that neighbouring farmers are keenly interested in the various experiments, and many of those who came to scoff, remained to praise—and in some cases went home to imitate.

THE ACCOUNTS OF A HAMPSHIRE FLOCK IN 1918-19.

SIR DANIEL HALL, K.C.B., F.R.S.,

*Director-General, Intelligence Department, Ministry of Agriculture
and Fisheries.*

THE Hampshire pedigree flock of 281 ewes, of which the following accounts are set out, is the property of the Lord Wandsworth Institution, and is kept on their Long Sutton Estate near Winchfield, Hants. The land in cultivation extends to about 700 acres, charged at an average rent of 20s. an acre, but less on the fields with which the present account is concerned. The land is comparatively high, mostly above 500 ft., and is a mixture of light loam and chalk and the heavier flinty soils which so generally rest upon the Downs. The flock was formed in 1915 by Mr. E. J. Bennett, of Chilmark. The foundation ewes were obtained from Mr. W. C. Young, of Stratford-sub-Castle, the late Mr. Coles, of Winterbourne Stoke, and Mr. B. Nichols, of Burntwood, Winchester. Rams have been bought from J. Fleming, D. Nichols, E. B. Blackwell and J. Ismay.

The season 1918-19 was not a good one for sheep in this district owing to the shortage of keep throughout 1918. In consequence the ewes were not in the best of condition at lambing time, and 2 of them died before lambing and 20 during the early summer. Lambing was on the whole late, and the persistent wet weather in the early part of 1919 was unfavourable both for lambs and ewes, with the result that the ram lambs were hardly forward enough for the summer sales and shows. The 279 ewes in the flock at lambing time reared 278 lambs only, of which 5 died subsequently.

The flock obtained H.C. for a pair of ram lambs and for a single lamb at the Cardiff Show of the Royal Agricultural Society and also H.C. and Reserve for a shearling ram.

The flock was kept in the usual manner and was folded throughout the winter upon turnips and a mixture of swedes and kale, and throughout the spring and early summer upon vetches and oats; fair crops in either case.

The accounts are kept upon the costs basis. The valuation of the ewes is preserved from year to year at a fixed figure of £4 per head on the 1st May, and they are carried forward at the closing of the account on 11th October at this figure of £4 plus the cost of their keep during the summer, plus the cost

of the rams that had been used for service during that period. The cost of any rams bought during the year is spread over two years, after which the rams are written down to a fixed figure of £7 as long as they remain in the flock. The accounts are set out below. The valuation of the flock shows little change during the year, but at the end of the time there were 46 fewer ewes and 51 fewer ewe tegs. The reduction in numbers of the flock was due to the sale of 26 draft ewes which had not been sold by 11th October, 1918, and to a further weeding out in 1919 in order to make room for 40 newly purchased ewes which have not been brought into the account. The fact that the total valuation of the flock had been little reduced as compared with this considerable reduction in its numbers implies that the ewes were carried forward at the end of the year at a higher figure per head. The costs of keeping the sheep during the six summer months had been much greater in 1919 than in 1918, and the valuation is made up of the fixed figure of £4 for the ewes together with their costs from May to October.

The crops consumed are charged on the basis of two-thirds of the cost of cultivation and the full cost of the seed, though the manures are carried forward to the succeeding corn crops. The grazing land, which is mainly indifferent upland pasture, is charged at its actual cost, since it was put to no other purpose. The hay, oats, and beans consumed, which were produced on the farm, were charged at market prices. It may be urged that there is a profit to the farm concealed in these charges, but inasmuch as there was a market for these materials, and in their place other foods would have had to be purchased, it is necessary to take them into the account at market prices in order to ascertain the profit or loss on the flock considered alone. We are in fact using the accounts to determine whether it is more profitable to keep the flock or put the land to other uses, *e.g.*, corn growing, as many flock owners have done. One other item in expenditure may seem very large; the general expenses, including management, which amount to £256. This item, however, is arrived at by dividing the general expenditure upon the farm, which cannot be allocated, in proportion to the outlay upon the labour for each department. It does, however, appear to fall somewhat heavily upon the corn land.

On the receipt side the ram lambs, upon the sale of which the success of the pedigree flock largely depends, did not do as well as they ought, because, as has been noted above, the flock is young and in this year the lambs were late. One ram was

let for the season for 170 guineas, another was sold for 50 guineas, a shearling was sold at 50 guineas and another shearling at 45 guineas, and the general average made by the ram lambs amounted to about 15 guineas a head. The fat sheep and lambs were sold under control in the ordinary way and realised an average of about 73s. a head, lambs in August and September making about 62s. each. The wool was sold at 2s. 8½d. per lb. The general result is a loss for the year of over £300, to which must be added some loss in the valuation for reasons indicated above. This loss is undoubtedly due to the great expenses which now attend an arable land flock. Nearly £500 was spent directly upon labour apart from the labour spent on growing the crops folded off. Of course this cost is much higher than a normal flock would require, because a pedigree flock requires a shepherd at a special rate and other extra attentions. The biggest item, however, in the costs is the food. The dry foods consumed amounted to £1,360, less a credit for £335 for manurial residues. The crops folded off were also expensive in view of the high cost of seed and labour. Dividing all the expenses on the basis of the number of ewes in the flock, and that is the only fixed datum, the ewe with its lamb throughout the year costs about £5 15s. for food, 26s. for labour, 17s. for service of the rams used, and 27s. management and sundries, roughly £9 5s. a head, against which about 22s. can be set off for wool, rendering it necessary to realise an average of £8 3s. per head for the lambs, both ewes and rams, on the basis of one lamb per ewe. When it is considered that half the fall of lambs will be ewes, and that of the ram lambs only a proportion can be sold for stud purposes, while the rest, together with the ewe lambs and cast ewes sold, only realise 73s. per head, a very high figure must be obtained for the stud ram lambs in order to make the flock pay. In the assumption that 100 per cent. of lambs are reared in addition to such ewe lambs as are required to replace ewes dying during the year, and that 60 per cent. of the ram lambs are fit for sale for stud purposes, these latter would have to realise an average of £17 a head in order to make the flock pay its way.

Putting aside certain particular and seasonal sources of loss, such as the poor fall of lambs, the bad season, and the fact that the flock has not been established long enough to secure the position in the market to which it might be considered entitled from its breed, there are certain more general sources of loss which affect all similar flocks. . In the first place, though the prices realised by pedigree stock at the present time look

very handsome, they have by no means increased in proportion to the costs of raising and managing the flock. The costs have certainly been trebled, but the increase in the average price of pedigree stock, great as it is, has been by no means on that scale. The stock sold for breeding, however, though one of the largest items in the receipts, by no means accounts for all the return, and a considerable part of the income of a flock is that derived from the lambs not fit for breeding and the cast ewes.

This is the only source of income in an ordinary flock that does not sell rams, and has as regards arable sheep been most adversely affected by the operations of control. It may be agreed that a flat price for mutton and lamb was inevitable under control, but it has borne very hardly upon sheep of the Hampshire class, indeed upon all the Down breeds. Breeders have relied for their income very largely upon the sale of lamb, from which they derived a special price in consideration of the time at which it is produced and the heavy artificial feeding involved. All these advantages have disappeared. The Hampshire lambs ready for market from May onwards have been selling at 10s. 9d. per stone, making about 60s. a head under control, as compared with about 7s. a stone or 40s. a head in the days before the War.

When one considers that the costs of production have at least trebled the reason for the losses in connection with a flock like this is evident. The mutton, sheep and lambs of this flock have averaged not more than 73s. a head, a figure which is quite inadequate as compared with the costs of production. Moreover, this failure to realise the proper price for lamb has re-acted upon the price for ram lambs. All the arable-land sheep have been hard hit and have seriously diminished in numbers during the period of control. Between 1913 and 1919 the average numbers of sheep in the country have fallen by 11·7 per cent., but this loss has fallen almost entirely upon the sheep on arable land, whereas the grass sheep have pretty well maintained their numbers. For example, Hampshire in 1913 contained 266,231 sheep, in 1919 165,657, a fall of 37·8 per cent., whereas during the same period in Cardigan, a county of grass-land sheep only, the numbers actually increased. The map which is here reproduced shows by its shading the changes in the sheep population of each county of England and Wales during the war period. It will be observed that the losses in the numbers of sheep are comparatively small over the western and southern parts of the country where grass sheep are mainly kept, but that they are very great in the arable counties in the east of England and



— REFERENCE —

Increases		shown thus. +		Decreases from. 21% to 25% shown thus.	
Decreases down	to 5% " "	" "	-	" " " " " "	26% " 30% " " " "
" " " " " "	from 6% " 10% " "	" "		" " " " " "	31% " 35% " " " "
" " " " " "	11% " 15% " "	" "		" " " " " "	above " 36% " " " "
" " " " " "	16% " 20% "	" "		" " " " " "	

Map showing the Increase or Decrease per cent. in the number of Sheep in 1919
as compared with 1913 in each county of England and Wales.

are at their highest in Wiltshire, Hampshire, West Sussex and Suffolk. The actual maxima of decline occur in the Isle of Ely and Holland (Lincoln), but the numbers of sheep there kept are comparatively small. It is, in fact, the sheep on arable land that have been reduced by the operations of control. The costs of keeping these sheep have increased enormously because they have to bear the heavy labour costs involved in folding and in the growth of green crops upon which the flock is fed. At the same time the receipts have not been enhanced in the same proportion because flock-owners have not been able to obtain the higher prices for lamb as compared with mutton upon which the financial success of the Down flocks depended in the past.

No separate statistics are available of particular breeds, but it is obvious from a consideration of these figures that breeds like the Hampshire Downs, the South Downs, the Oxfords and the Suffolks must have lost something like half their numbers during the later years of the War, when control of meat prices existed. This diminution in numbers can be set down to the enhanced cost of production, the unremunerative price of lamb and the temptation held out to the flock-owner to realise his ewes and to sell his hay at the high prices that have been prevailing for that commodity, while at the same time he could, for a time at any rate, grow profitable corn crops in place of the unremunerative fodder crops formerly grown for the flock. The general decline that was going on in the numbers of arable land sheep has further reacted unfavourably upon the market for ram lambs, the demand for which on a flock of the type described has naturally fallen when so many of the non-pedigree commercial flocks were being given up. It is clear that until the market resumes a more normal condition and early lamb obtains a price commensurate with its cost of production, the folding of sheep upon the arable land will continue to be unremunerative. Were the present range of prices to continue it would be necessary to effect a complete change in the farming system that has hitherto prevailed upon the chalk areas, for that system is essentially based upon the consumption of green crops upon half the arable area as the best preparation for the succeeding corn crops.

The accounts further illustrate the unremunerative character of pedigree stock breeding in the early years before the name of the herd or flock has been made. The quality of the produce may be undeniable, but a place in the charmed circle of big prices depends very much upon the personal skill and advertising art of the owner.

THE LORD WANDSWORTH INSTITUTION.

Hampshire Down Sheep Account.—11th October, 1918—11th October, 1919.

1918.—11th October	£	s.	d.	£	s.	d.	1919.	£	s.	d.
To Capital Account—							By Ram Lambs Sold (158)	..	..	..
281 Flock Ewes at £4	..	1	124	0	0	0	(1 Let, 170 gs.; 1 Sold, 50 gs.)	..	..	903 16 4
26 Draft Ewes unsold at £4	..	104	0	0	0	0	" Fat Sheep, Cast Ewes and Lambs (304)	..	..	1,108 0 5
2 Rams .. ..	..	189	0	0	0	0	" Shearlings (14)	..	..	255 7 6
2 " at £7 each	..	14	0	0	0	0	(1 Sold, 50 gs.; 1, £45)	..	..	..
Keep of above, 1st May to	..	651	0	10	..	..	" Wool .. ..	..	..	326 18 10
11th October .. ..	..	164	13	6	..	..	" Manurial Residues ..	..	..	335 7 2
14 Ram Lambs (bred) at cost	..	566	2	0	..	..	" Sundries .. ..	..	..	36 2 6
120 Ewe Tegs (bred) at cost	..	..	..	..	..	..	" Valuation—	..	..	..
Labour .. ..	..	2,812	16	4	..	..	261 Ewes at £4, plus £210 (Purchase and Hire of	..	..	..
" Horse Labour ..	..	405	13	5	..	..	2 Ram Lambs), and Cost of Keep;	..	..	..
" Purchased Foods Consumed..	..	88	4	6	..	..	4 Rams at £7, plus Cost of Keep;	..	..	..
" Crops Consumed .. ..	..	662	8	9	..	..	20 Ram Lambs (bred), at Cost:	..	..	..
(Average Cost per Acre—	..	673	16	7	..	..	69 Ewe Lambs " ..	..	..	2,766 7 8
Mangolds .. ..	..	16	7	7	..	..	" Loss .. ..	..	..	311 6 9
Turnips, Swedes, Kale ..	..	7	18	3	..	..		
Vetches) .. ..	..	3	16	8	..	..		
" Fields Grazed .. ..	..	74	9	0	..	..		
(Average Cost per Acre) ..	..	1	4	1	..	..		
" Hay Consumed (at Market Price),	..	402	16	3	..	..		
£7 15s., plus Labour ..	..	295	7	2	..	..		
" Oats, Beans Consumed (at Market	..	161	11	9	..	..		
Price), plus Labour .. ..	..	256	3	5	..	..		
" Sundries .. ..	..	157	10	0	..	..		
" General Expenses, including Manage-	..	52	10	0	..	..		
ment .. ..	..	..	..	..	..	..
" Ram Lamb Purchased .. ..	..	..	..	..	..	..
" " Hired .. ..	..	..	..	..	..	..
	..	6,043	7	2	..	..		
	..	6,043	7	2	..	..		

OUR NATIONAL FOOD SUPPLY:

LIMITS OF SELF SUPPORT.

THE following notes are an abstract of the first of three Chadwick Lectures delivered at the Royal Sanitary Institute by SIR DANIEL HALL, K.C.B., F.R.S., :—

It is well known that of late years the United Kingdom has been very largely dependent upon imported food to maintain its population. To what extent do we feed ourselves? In order to obtain comparable figures it is necessary to reduce all foods to a common standard. Mere weight will not compare bacon with bread or eggs with milk. The common standard we require is obtained by ascertaining the value of the food as fuel to keep the machine of the body running. The body behaves like a machine; it takes in food just as an engine requires coal, and the more work the body does the more fuel must be burnt up in it. Scientific men, therefore, value food in units called calories, which measure the value of the food as a means of doing work. There are other elements in food to be considered, particularly the protein content, protein being required to repair the waste of the tissues. But in an ordinary mixed diet if the calories are sufficient to keep the machine running the food will also supply enough protein. A man doing light work will want about 3,000 calories a day.

Towards the end of 1916, when the question of the nation's food supply began to be urgent, a Committee of the Royal Society summed up the diet of the nation for the five-year period prior to the War, and according to its figures in those years the total food supply consumed would have supplied each man, woman and child in the United Kingdom with 3,091 calories a day.* Only about 42 per cent., however, of this food was produced within the United Kingdom. Of the most important elements in the food of the country, *i.e.*, bread, only one-fifth was produced at home, but something like 60 per cent. of the meat and nearly all the potatoes were grown here.

How did we get into this dangerous position? At the beginning of the Nineteenth Century the country was practically self-supporting, but the growth of population had altogether outstripped the increased productivity of the land. Moreover, for the period of forty years before the War the productivity of the land had been steadily declining owing to

* See this *Journal*, February, 1917, p. 1046.

changes in agriculture. From the productivity point of view 1872 represents about the high-water mark of British farming. At that time in England and Wales there were nearly 15,000,000 acres under the plough; by 1914 that figure had fallen to less than 11,000,000—by 26 per cent.—and the wheat acreage had dropped from 3,500,000 to about 1,800,000. Nearly 4,000,000 acres of land had been put down to grass, and carried cattle and milch cows instead of growing crops.

From the point of view of food supply, the meat and milk produce from grass land do not make up for the crops that might otherwise have been grown. This is a cardinal factor to bear in mind in connection with the national food supply.

Grass land is comparatively unproductive of food as compared with arable land. There are two reasons for this. In the first place, on the uncultivated grass land there is actually a smaller production even of cattle food. On average land three times as much cattle food can be grown as would be produced by the uncultivated grass land upon a similar area. Secondly, the production of meat, milk and all animal products involves a great loss of absolute food. The animal is an indifferent converter of the material grown by the land. The pig is the best converter amongst animals, but even a pig will consume 7 lb. of barley meal in order to produce a pound of pork, and the pound of pork does not contain as much human food as the pound of meal. Of course the cattle can utilise a great many coarse fodders and waste produce which are unsuitable for human consumption. But none the less they are consumers of the products of land which might have been growing something like ten times as much human food of a vegetable character.

When a population is driven to subsist on or near the minimum it must become increasingly vegetarian in its diet.

Amongst the animals the pig is the best converter; milch cows come next, then sheep, while the manufacture of beef is the most wasteful of all.

The superior power of arable land to maintain human beings is illustrated by Sir Thomas Middleton's calculation that 100 acres of arable land in this country is normally producing food that will maintain 84 persons, whereas the same 100 acres under grass is only maintaining from 15 to 20 persons.*

In the face of these facts, why not at once put all the land under the plough? That was the line of policy of the Food Produc-

* This subject was dealt with in an article "Farming in the United Kingdom in Peace and War: the Plough Policy and its Results," by Sir Thomas Middleton; see this *Journal*, March, 1920, p. 1192.

tion Department during the War, and they had succeeded in 1917-18 in adding 1,150,000 acres to the area under the plough.

The difficulty then was the lack of labour, horses, implements and buildings, and the same difficulty faces us now, when it is still the prime national interest to make our own land produce as much as possible and buy as little as we can from abroad.

The crux of the question is the amount of labour that arable land requires, and its increasing cost., It was this factor which above all others drove the land down to grass during the last 30 years of the Nineteenth Century. The value of the produce of arable land was constantly falling until there was not enough to pay for the cost of labour. Roughly speaking, 100 acres of arable land require the labour of four men, whereas 100 acres of grass land will want at the most two men if milk is being produced, and only half a man or less if cattle and sheep are being grazed. The difficulty before the farmer that causes him to hang back from increasing his arable area at the present time is that the costs of labour have risen disproportionately to the price of his produce. Before the War a farmer growing an acre of wheat would get about £7 for the produce, out of which he had to pay about 30s. for manual and 15s. for horse labour. At the present time that 30s. has become 100s., the 15s., 30s., whereas the 140s. has only become about 280s. Even if his rent has not risen, the margin of profit can be no higher than it was before, whereas the risks are of course very much greater. By comparison the grass land is a much more tempting proposition. On the grass land the labour only amounts to 10 per cent. of the value of the produce instead of 30 per cent., or rather 45 per cent. including the horses, as it does on the arable land. The available margin of profit when the value of the produce has doubled is, therefore, much more tempting than it was before. The chief factor of cost in grass land farming is the rent of the land, and that has increased but little. Labour is the chief factor of cost of arable land, and that has trebled in cost. There is still a greater profit to be obtained from arable land, but it is more speculative, harder work, and demands more skill and enterprise on the part of the farmer. Much as the nation needs arable land, in the present uncertain conditions of prices and labour, the farmer will be tempted towards grass land as long as the prices of corn, which is the chief produce of arable land, are kept down. Land in England is cheaper, especially rented land, than land in any other part of the world, and this of itself is an inducement to farm under grass.

One is often asked whether the United Kingdom could become self-supporting in the matter of food. It is, perhaps, rather an academic question, because the question of cost and profit will always dominate the situation. However, I have calculated what an acre of arable land, suitably distributed, could be made to yield of the main items of necessary food. From the table opposite it will be seen that on an acre of arable land, assuming the average yield of the arable land of to-day, one person could be maintained for a year. We have a population of 45·3 millions, and 46·1 million acres of cultivated land, grass and arable, in the United Kingdom. We might think, therefore, we could maintain our population and give individuals the same number of calories as they were getting before the War. They would have to eat a little less meat and a little more vegetables, but the diet would be a perfectly healthy one. This calculation, however, assumes that all the land of the country could be made to yield as well as the present fraction that is under the plough. This fraction, however, comprises by far the best land, and with all the improvements that we can consider possible in farming we could not make the whole area yield as well as the current arable land. The calculation also assumes that in the production of meat and milk, theoretically perfect use is made of the cattle food, whereas, in practice, before the War the country used something like three times as much cattle food as would be necessary for the theoretical output of meat and milk. Again, the calculation assumes that all the land is devoted to feeding human beings, whereas at the present time it has to support in addition the horses, both those wanted on the farms and those at work in the towns. Thus the table I have given you is a curiosity only and has little bearing upon what we may reasonably expect.

All the same the food crisis is not over, and we must turn over to a much **greater** extent to arable farming. Quite apart from question of price there will not be in future the same margin of food in the world for importation that there was before the War. Everywhere there has been a great withdrawal of labour from the land, and this will be seen year by year in a diminution in the total food supply. Moreover, the United Kingdom is fundamentally and without disguise very much poorer than it was before the War and cannot purchase as it did once in the common markets of the world. These factors will force us to grow more of our own food and to pay the prices necessary to make the arable farming, by which land this greater production

can be assured, profitable to the cultivator of the soil. At the same time the great bulk of the population will have to change its habits with regard to food and meet the higher prices by a great proportional consumption of those articles of food which are essentially the cheapest. That means, in the first place, an increased consumption of bread, potatoes and vegetables instead of meat. Amongst the animal products, milk and milk products are cheaper foods than meat. Pork will have increasingly to replace other meats, and beef, especially the prime beef of which our farmers were so proud, will become an expensive luxury.

Theoretical Produce from an Acre of Arable Land as compared with the pre-war Consumption of a Unit of the Population of the United Kingdom.

Parts.	Items.	Yield per Day.		Pre-war Diet per Day.	
		Amount.	Calories.	Amount.	Calories.
8	Wheat, $\frac{1}{4}$ th acre	18 oz. bread	1,360	{ $\frac{1}{4}$ lb. bread	1,067
	„ offals	$\frac{1}{4}$ oz. bacon	42	{ $1\frac{1}{2}$ oz. cereals	
10	Milk, $\frac{1}{4}$ acre	$\frac{1}{2}$ pint milk	203	$\frac{1}{4}$ th oz. bacon	134
	„ „	1 oz. butter	200	$\frac{1}{2}$ pint milk	194
				1 oz. butter,	198
				marg., and lard	
	„ „	$\frac{1}{2}$ oz. cheese	64	$\frac{1}{4}$ oz. cheese	35
1	Potatoes, $\frac{1}{4}$ th ac.	1 lb.	250	1 lb.	241
2	Vegetables and	2 lb.	240	1 lb.	114
	Fruit, $\frac{1}{4}$ th acre				
1	Sugar Beet, $\frac{1}{4}$ th acre	4 oz. sugar	465	$3\frac{1}{2}$ oz. sugar	409
18	Meat, $\frac{1}{4}$ th acre	$4\frac{1}{2}$ oz.	337	6 oz.	461
	Sundries ..	..	..	..	151
40			3,161		3,004

THE TECHNIQUE OF CROSS-FERTILISATION IN POTATOES.

REDCLIFFE N. SALAMAN, M.A., M.D.

Large numbers of potato growers who are also potential raisers of new varieties of potatoes may find the following notes on the technique of cross-fertilisation of interest and value to them in their work. The operations of cross-fertilisation described might usefully receive the consideration of agriculturists.

Construction of the Flower.—The well-known flower of the potato plant is hermaphrodite, that is to say, both male and female elements are contained in one and the same flower.

The Female Organs.—In the centre of the flower is an ovary from which there projects a thin, green rod, the pistil, which terminates in a cushion-like knob known as the stigma. When the flower is ripe for fertilisation a slight sticky secretion appears on the stigma. The shape of the stigma varies in different potatoes, being notably cleft like a hot cross bun in some while quite small and round in others.

The Male Organs.—Ranged round the ovary are five yellow anthers on short, thick stamens; each anther is made up of two lobes. On the inner side of the anther each lobe will be seen to have a longitudinal depression (line of dehiscence) to its outer side, and as the anther ripens this depression ends in a small aperture on the inner side of the apex of each lobe. It is from this aperture that the pollen escapes. In nature the stigma is fertilised by the pollen of its own flower, which reaches it by being scattered from the anther through the small hole and falling on to the ripe stigma. It is found, however, that insects of all sorts freely visit potatoes when in bloom, and bees will undoubtedly hover over the flowers and carry pollen from one plant to another, so that in cross-fertilisation for scientific purposes it is necessary to take certain precautions which will be dealt with in detail later.

Difficulties in Cross-Fertilisation.—It is common knowledge that many potato plants form buds which never open, or at least fall before the flower opens. As a matter of fact varieties differ very much in respect to this property. There are some whose buds fall when they are no more than $\frac{1}{2}$ in. long; there are others whose buds will grow till they reach a length of $\frac{1}{2}$ in. or more and then fall; others, again, will bear buds which actually open and form flowers, but these flowers drop within

a few hours. Such plants are extremely bad subjects either as male or female parents. Those whose buds fall in the earliest stages are, of course, useless for cross-fertilisation; those whose buds do not fall until considerably later can be used as female parents, but the chance of obtaining a successful result is very small. As male parents such plants are useless, for the pollen does not ripen till the flower is well open, and it will be found that such flowers as do eventually open will have no pollen.

Another difficulty a potato raiser has is that a number of excellent varieties which produce beautiful blooms bear anthers which contain no pollen. A striking example is Up-to-Date. Of such plants it is true that by infinite perseverance an occasional flower—perhaps one in three thousand—can be fertilised, but even so, very few seeds will result. On the other hand, such plants are perfectly suitable as female parents and may be fertilised with the pollen obtained from any variety.

Importance of Observance of Technique.—In crossing any two varieties it is presumed that the raiser has a definite object in view and that he hopes to obtain offspring whose qualities will bear some definite relation to those of the parents he is employing. It thus becomes essential that he shall be perfectly sure that in making the cross the seed which arises is due to the union of the pollen he has introduced with the ovules or eggs of the mother plant. There must be no uncertainty as to whether these maternal ovules have been fertilised with pollen derived from their own anthers or with pollen possibly derived from a neighbouring and different variety and carried to the mother plant by a bee or other insect. It is therefore essential that he should observe a certain technique, and it is this technique which will now be described.

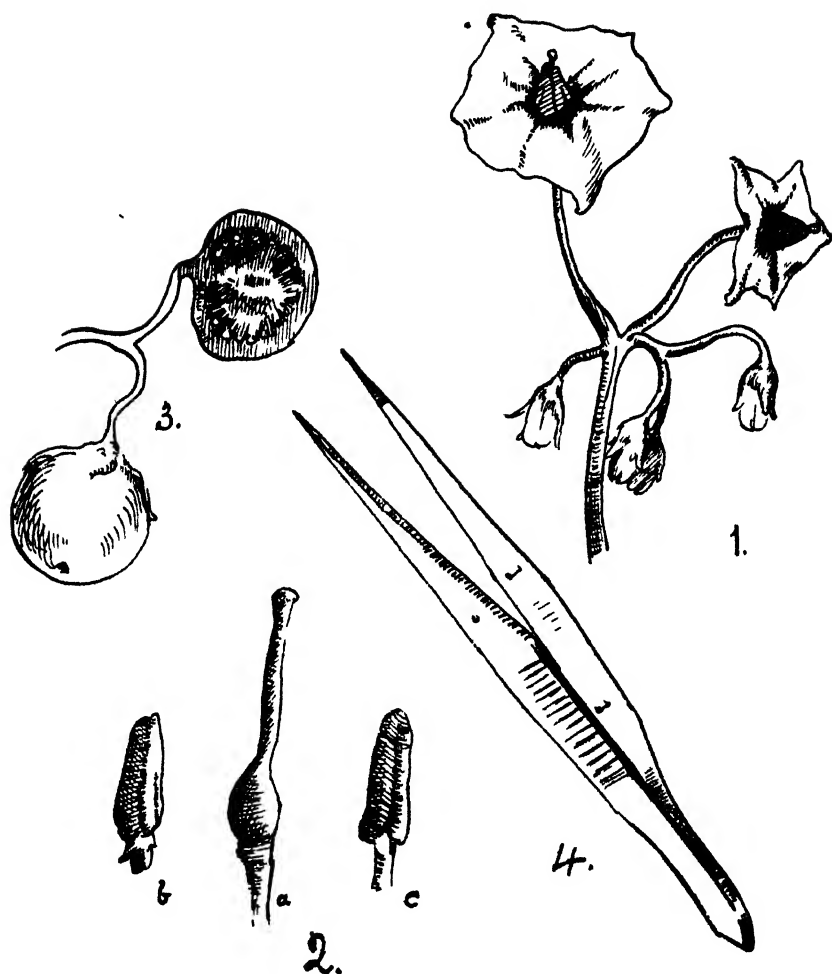
The raiser should provide himself with (a) a pair of fine-pointed surgical forceps about $3\frac{1}{2}$ in. in length, (b) a small narrow-necked (2-ounce) bottle filled with rectified spirit, (c) small shop labels about $1\frac{1}{2}$ in. by 1 in. with a fine string loop by which they can be attached to the stem of the flower (such labels are used by jewellers and other tradesmen for pricing small articles), (d) parchment paper bags about $9\frac{1}{2}$ in. by 6 in. (such bags are specially made for the purpose by Messrs. John Miller & Co., Ltd., 322-334, St. George's Road, Glasgow), and (e) copper wire $\frac{1}{32}$ in. in diameter, which should be cut into lengths of about 5 in.

Sterilisation.—Having chosen the mother plant, a cyme, or bunch of flowers, should be selected, and all flowers already

open should be nipped off with the forceps, leaving from three to five buds. These buds should, as far as possible, be all of the same size, about $\frac{1}{2}$ in. in length and in such a stage as to be ready to open. Buds which are considerably younger than this should be removed. The operator then dips his forceps into the bottle of alcohol for one or two seconds, shakes them to allow them to dry, then takes the bud between the finger and thumb of his left hand and very gently pushes open the petals. He will then find the anthers closely clustered round the stigma, and on inserting the fine point of his forceps very carefully between any two on the anthers and pushing the anthers outwards, he will find that they break off and are readily removed. All five anthers must be similarly treated and every bud of the group must be likewise emasculated. With very little practice the raiser will find that he can do this without in any way injuring the stigma. This done, he should affix to the stalk of the cyme a label stating the name of the maternal variety and the date of sterilisation. It is advisable that the forceps should be sterilised by re-dipping in the alcohol after each separate bud has been dealt with, lest any of the anthers may have been prematurely ripe and shed pollen on to the forceps, which might thus be accidentally conveyed to the stigma of the next flower. The bud having now been sterilised and the label affixed, the next step is to preserve it against contamination by insects. This is done by placing the group of buds within a parchment bag. The bag should be opened over the end of a round stick and on no account should it be blown into. When opened it is placed carefully over the buds, and the edges of the bag brought firmly together in a cluster round the stalk, and secured in that position by winding some of the copper wire already described around the neck of the bag. The label should be allowed to hang outside the bag.

Fertilisation.—If the weather is warm the buds within the bag will open fully from within 24 to 48 hours, and it is when they are open that fertilisation should take place. The most opportune time is when the stigma has the shiny and sticky secretion on it, but successful results may be obtained when this is absent. Probably the best time of the day is between 10.0 a.m. and mid-day, since as the day begins to cool the petals close and the flower is more difficult to manipulate and possibly not so ready to be fertilised.

Having selected the paternal parent the operator should remove the open flower and carry it to where the female plant



1. A Cyme with open Flowers and Buds.
2. (a) Pistil and Ovary; (b) Anthers from inner side—showing faint line of dehiscence in either Lobe; (c) Anther from the outer side, all enlarged.
3. Potato fruits; the upper one shown in section exhibits the seed.
4. A suitable pair of forceps.

is growing. The paper bag should then be removed, and the copper wire straightened out ready to be reapplied. Before proceeding with the operation of fertilisation the operator should sterilise his forceps and the thumb and forefinger of his left hand by means of the alcohol in the bottle—the fingers should be sterilised by allowing a few drops to run over them. When the alcohol has dried off, which it rapidly does in the open air, he should seize one of the anthers at its basal attachment with the forceps and hold it between the thumb and forefinger of the left hand in such a way that the line of dehiscence of the right-hand lobe is uppermost. With the forceps in the right hand the anther is gently split open along the line of dehiscence with the point of one blade of the forceps, and in so doing it will be found that a minute heap of white dust accumulates on the point of the forceps. This is the pollen.

The operator now very gently spreads the pollen on to the stigma of the female flower. This should be done so that the metal of the forceps scarcely touches the stigma at all, and the pollen should be distributed over the whole surface of the stigma. When the right-hand lobe of the anther has been thus emptied it is quite easy to turn the anther over in the fingers and expose the left-hand lobe and open that one in a similar manner. Where the pollen is abundant two flowers can be fertilised from each lobe, but this naturally varies with the amount of pollen and the skill of the operator. Having fertilised the flowers, the next step is to write the date of the operation and the name of the paternal plant on the label. The bag should then be replaced in exactly the same manner as it was put on. Forty-eight hours after fertilisation the operator should remove the bag and very gently nip off the stigma, leaving the pistil standing. This done, it is unnecessary to replace the bag. Within three or four days the flower will droop and the corolla fall off, and if fertilisation has been successful the individual flower stalk will thicken and the little cork joint which is to be found normally about 1 in. beneath each flower will become absorbed. At the same time the ovary swells into a berry which in ordinary varieties is round and like a tomato.

Growth of the Berry.—In most varieties the berry will grow till it is about 1 in. in diameter, but it is highly advisable when it has attained a size of about $\frac{1}{2}$ in. in diameter to fix a bag round it. The reason for this is that the berries must be left until the haulm dies down, and when this occurs it frequently happens that the berries either drop or are lost sight of at

digging time and many valuable fertilisations are lost, but if the bag is put back and fixed with its copper wire to the stem with its label carefully preserved inside, then the raiser is not robbed of his labours.

When the haulm has died down, the berry with its label attached and still contained within the bag should be removed. By this time it will be found that the berry is probably as much as 1 in. in diameter, is of a green colour shading off into purple, and is still quite hard. It should then be kept, still within the bag, in some open tray in a safe place protected from mice and other possible sources of injury. In February of the following year the berries should be opened and the seed extracted. This is quite a simple procedure. With a clean penknife the berry is split in two, the seeds squeezed and scraped out and spread on a piece of clean white blotting paper, 6 in. by 6 in., on which the name of both parents and the date of fertilisation should be written. Each seed is surrounded by a coat of mucilage which, on drying, will cause the seed to adhere to the blotting paper. When dry the blotting paper may be folded and kept in an envelope.

Sowing the Seed.—In the beginning of March the seed should be sown. It is first necessary to separate the seed from the blotting paper, which is readily done with a penknife. Sowing may be carried out in two ways: (a) the seed may be sown broadcast in pans and covered with silver sand and 6 weeks later pricked out, or, preferably (b) sown in a systematic manner in seed boxes. The soil surface of the seed box should be marked out in lines $2\frac{1}{2}$ in. apart, drawn parallel with both its sides and ends, the first line starting at $1\frac{1}{4}$ in. from the edge of the box. In this way a checker-board is produced, and if a single seed is placed at each intersection at a depth of 1 in., then the ensuing plant will be $2\frac{1}{2}$ in. from its nearest neighbour. By employing this method there is no need to prick out, and each seed is given a fair chance. The seed should be raised under very moderate heat, and when the seedlings are about $1\frac{1}{2}$ in. high they should be cooled off and hardened. They will not, however, be fit to plant out till the first week in June, when each seedling will be from 6 in. to 9 in. high.

Other Methods of Fertilisation.—It sometimes happens that the operator is not able to pay the necessary number of visits to his plot in order to effect the fertilisation in the manner described, and experience has shown that results can be obtained, though the method is not nearly so certain, by fertilising the bud immediately after its anthers have been removed. In

this case it is advisable to employ an abundance of pollen and then replace the bag and leave it for several days.

Some investigators will require to self-fertilise rather than to cross their plants. In this case the procedure is simplified. It is only necessary to remove all open flowers from the cyme and to protect the unopened buds (without further operation) by the bag, affixing the label as before. When the flowers are opened an anther should be removed and the pollen distributed on the stigma in the same manner as was done when cross-fertilising. The bag should then be replaced. It is important to remember that the sterility of an anther, so common in potatoes, is a dominant Mendelian character, and unless this is recognised difficulties will arise in later generations.*

Raisers should not be disappointed if they find the number of successful fertilisations to be small. Over a large number of years and using a great variety of plants, the number of successful fertilisations was never more than 5 per cent. of individual flowers treated, or, allowing three flowers to each pollination, 15 per cent. of the total number of female parents.

* For information on this subject the investigator is referred to the following papers :—

“ The Inheritance of Colour and Other Characters in the Potato,” *Journal of Genetics*, Vol. 1, No. 1, Nov., 1910.

“ Male Sterility in Potatoes,” *The Journal of the Linnean Society, Botany*, Vol. xxix., October, 1910

SOCIAL SERVICE IN RURAL AREAS.*

SIR HENRY REW, K.C.B.

It is not necessary to dilate upon the urgent importance of the development of social activities in the country districts. The dullness of village life has long been recognised as one of the main reasons for the migration of the sons of the soil to scenes of fuller activity, but efforts to alleviate it have been spasmodic and sporadic. The time has come when the human needs of the countryside have become insistent, and the future of agriculture is seen to involve a sociological, as well as an economic, problem.

In one respect efforts to stimulate social activities in rural life start with an advantage. In many, it may perhaps be said in all, country villages there is a tradition of social service which only needs to be re-invigorated and adapted to the new conditions. It is easy to sneer at the Lady Bountiful conception of human relationship, but criticism of it should be directed rather to the social system under which it existed, than to those who honestly tried to fulfil the responsibilities which fell upon them, and to do their duty conscientiously in that state of life to which they had been born. This spirit of social responsibility, which was the appandage of the inheritors of the patriarchal scheme of village life, must be widened and cultivated, so that all members of the community shall feel that their duty to their neighbour is a mutual obligation.

But if the countryside has a tradition of social service which may be counted for righteousness, it derives from its past other qualities which increase the difficulties confronting all attempts to revive the communal spirit. The psychology of the countryman is baffling, even to those who have spent their lives in the country. The recent improvement in the economic status of the farm worker, and still more the self-confidence which organisation awakens, have presented him in a new aspect to many who thought themselves well acquainted with him. The young men who return to the villages from the army have to a large extent abandoned the mask which has so long hidden the working of the rural mind. They have not only found expression, but they have thrown off timidity. Their fathers were inarticulate and timid by habit and instinct. Their real

* Read before the Conference of the National Council of Social Service at the Sheldonian Theatre, Oxford, on Thursday, 8th April, 1920.

feelings and thoughts were only discoverable by a few who combined insight with observation. One of the few—the author of “Folk of the Furrow”—who took peculiar trouble to observe and has also the gift of insight, says: “The people on the land have not been easy to approach because their qualities have been found difficult of interpretation by those who have not had the opportunity to penetrate below the surface.” It is true that from time to time there have arisen from the ranks of agricultural labourers, spokesmen who have voiced the aspirations of their class, but they were little heeded and their right to be regarded as representative was challenged. Now the farm workers are organised, and those who speak as their representatives can do so with the confidence which the authority of numbers gives. From them we know that the outlook of the men who live by the land is not restricted to wages, but that they are also claiming better opportunities for enjoying the amenities of life. They are before all a practical race, and have a wholesome distrust of those who promise the millennium. But they do insistently demand that life in the villages shall comprise something more than toil, and that its amenities shall extend beyond the limited resources of the ale-house.

This demand must be met, and met without delay, if English rural life is to continue, and a countryside population, which is so vital to the welfare of the nation, is to be maintained. The demand is universal. The organisers of the Village Clubs Association have only been actively at work for a very few months, but in all parts of the country they have visited—from Lancashire to Sussex, from Norfolk to Devonshire, from Hertfordshire to North Wales, from every county and district—the demand is the same. The Women’s Institutes, of which there are some 1,500 throughout England and Wales, testify to the same urgent need. All recent inquirers into the rural problem are insistent on the subject. The case is well put in the Report of the Adult Education Committee, of which the Master of Balliol was Chairman:

“The rural problem, from whatever point of view it is regarded—economic, social or political—is essentially a problem of re-creating the rural community, of developing new social traditions and a new culture. The great need is for a living nucleus of communal activity in the village, which will be a centre from which radiate the influences of different forms of corporate effort, and to which the people are attracted to find the satisfaction of their social and intellectual needs. We conceive this nucleus to be a village institute, under full public control. Its size would vary with the number of people it was designed to serve. . . .

"The institute should be the headquarters of organised local activities of all kinds. Trade union branches, friendly societies, pig clubs and bee clubs, and agricultural and horticultural societies of one sort and another, adult schools and classes arranged by voluntary organisations, women's institutes, schools for mothers, chess clubs, and so forth, should be encouraged to use the institutes; and one or more rooms, as may be necessary, should be provided for the purposes of their meetings. The institute should contain a hall large enough for dances, cinema shows, concerts, plays, public lectures, and exhibitions. At the institute there should be a public library and local museum. If arrangements can be made for games and sports, so much the better. The institute, in a word, should be a centre of educational, social and recreational activity."

This passage expresses fully and forcibly the primary aim of the Village Clubs Association. The Women's Institutes, although they were formed, as their name implies, for only one sex, and did most admirable work during the War when so many of the other sex were absent from the villages, are now co-operating cordially in the effort to extend the principles which they advocate, so as to embrace all the members of the community.

The difficulties of providing buildings where they do not exist are at the present time very great. The suggestion of the Committee just quoted, that village halls should be provided out of public funds, is one which has obvious attractions, and unquestionably a very strong case can be made out for the adoption of this course. A building in each village, held in trust for the benefit of the whole community, and free from any restrictions as to its use, other than those necessary for order and decency, would be a public advantage, and it would provide facilities for carrying on public work, such as, for example, continuation schools, which may often be hampered by the lack of such accommodation. A village hall is as necessary as a town hall, although the purposes which it should serve are more varied and comprehensive. Its design would be different, and its accommodation proportioned to the needs of the population, but it should be essentially the centre and focus of the active life and social interests of the community.

Local authorities have at present certain powers of rendering financial assistance for the erection of village halls.

District Councils can, as part of a housing scheme and subject to the approval of the Ministry of Health, provide a Public Hall, and in such a case the financial assistance given by the Exchequer to Housing Schemes would be available.

Parish Councils may levy a Rate not exceeding 3d. in the £ (or, with the consent of a Parish Meeting, up to 6d. in the £).

This is the maximum allowed, and must cover the whole expenditure of a complete financial year. It may include the provision and maintenance of buildings required for Public Offices, meetings, etc. But subject to this limitation they may further the erection of village halls in the following ways :—

- (a) If the hall were erected by voluntary subscriptions they can accept it as a gift for the benefit of the inhabitants of the Parish, and so become responsible for its future maintenance.
- (b) They can contribute towards the cost of erection, as a war memorial, with the sanction of the Ministry of Health.
- (c) They can contribute towards the cost of erection, as a building which would be partly used for public offices or for meetings, and could raise a loan for this purpose with the sanction of the County Council.
- (d) They can erect the building as a war memorial and for public offices or for meetings (with sanction as above mentioned) and receive voluntary subscriptions as contributions towards expenses.
- (e) If the building were to be used partly as a public library they can take action by adopting the Public Libraries Act, 1892, which would enable them to raise a *1d.* rate for that express purpose. The adoption must be by the Parish Meeting
- (f) A Parish Council may let any building vested in them, but in the case of a building erected at the expense of the rates, may not do so for more than one year, without the consent of the Ministry of Health.

Under the Ministry of Agriculture and Fisheries Act, the new county agricultural committees are directed "to make such inquiries as appear to them to be desirable with a view to formulating schemes for the development of rural industries and social life in rural places, and for the co-ordination of action by local authorities and other bodies by which such development may be effected, and shall report the result of such inquiries to the Board and to any local authority or body concerned, and the expenses incurred by the Committee under this sub-section to such amount as may be sanctioned by the Board with the approval of the Treasury shall be defrayed by the Board."

This express statutory recognition of the importance of the development of social life in rural places is satisfactory and

significant. The county agricultural committees must be set up within six months after the passing of the Act, but it is premature to speculate what the results of their action may be.

There are 62 County Councils, 650 Rural District Councils, and over 7,000 Parish Councils in England and Wales, and only a very sanguine person will expect that all of them—or even any considerable proportion—will immediately use even the limited powers they possess for the development of social life in the villages. While, therefore, doing all that may be possible to secure substantial assistance, whether pecuniary or otherwise, from public authorities, we cannot afford to wait, and it is better to assume that, in the future as in the past, voluntary effort is imperative if timely and effective progress is to be made. Much has already been accomplished by the public spirit and enterprise which still happily characterise English men and women. A large number of village halls are already erected, sometimes by individuals and sometimes by the collective energy of the community. We are gradually collecting data which will in due time enable us to compile a record of the village halls and institutes throughout the country, but our information is still far from complete. The Village Clubs Association and the Federation of Women's Institutes recently had occasion to make inquiries in a certain number of villages, and received reports from 356 villages scattered over 46 counties which indicated that in a considerable number of those villages club-houses or institutes, available for the use of all the inhabitants, were in existence.

In spite of the great difficulty of building, much is being done. In many villages the collection of funds for the erection of a hall or institute is actively proceeding, and in this work the Women's Institutes are rendering most valuable service. Feminine ingenuity and assiduity in financial matters are being devoted with exemplary zeal to levying, both by direct and indirect methods, contributions from all classes of the community towards the provision of a hall or institute for the use of all the inhabitants. It is a very hard task in many of the smaller and more remote communities, where persons of means are few or apathetic. There is no doubt, however, that the effort to erect their own hall is in itself a stimulus to the communal spirit. Instances have come to notice where a building is being gradually erected by the personal labour of the villagers, and the result in such cases will be a pride of possession which can never be aroused in the same degree by the acceptance of a gift. Provision from extraneous sources is therefore not an

unmixed blessing, and, personally, I should prefer that funds should be available to supplement local effort rather than to supplant it. Is it too much to hope that some person or persons of wealth will see an opportunity of promoting in the most direct way the happiness and contentment of our villages, and thereby winning immortal fame, by providing a fund from which grants could be made to enable those who are doing their utmost to help themselves, to complete their work before they abandon it in despair?

The recent establishment of a Rural Department of the Council of Social Service testifies to the general recognition of the importance and urgency of the rural problem. The initial need for some co-ordinating body is great. I have spoken of efforts already being made, and it is quite true that more is being done throughout the country than is generally known. Those who are doing it are not given to advertisement, and in these days much of the best work is the least advertised. Even those who are well-informed with regard to social work in the towns are often ill-informed as to activities in rural districts. In a book just published, which gives a very useful introduction to the whole subject of social service, only two or three pages are devoted to work in the villages, and no indication is given of the attempts which are being made to grapple with it. We are hoping to modify that kind of attitude. The Rural Department is intended to ensure that the rural side of the problem secures at least its proportionate share of attention. We are well aware that this is predominantly an industrial country, and that the inhabitants of rural districts in England and Wales, according to the last census, represent little more than one-fifth of the total population. We recognise that the complexity of town life presents special difficulties to the social worker. But we claim that the maintenance in comfort and contentment of the rural population has an importance to the State which cannot be measured by arithmetic, and that the comparative simplicity of country life is in itself an impediment to social organisation.

I make no attempt to formulate a definite programme. We stand in the first instance for the principle of co-ordination of all efforts for the betterment of rural conditions. We seek the co-operation of all persons of good-will who are aiming in diverse ways to assist and develop social activities in the villages. Co-ordination and co-operation do not imply centralisation. The only centralisation we want is a centralisation of ideas, and the only combination we want is a combination for mutual

help and inspiration of those having similar aims. The bed-rock basis of the two organisations * for which I speak is self-government for every unit. It is possible that social work in the towns may in some degree be standardised. But it is certain that you cannot standardise the country districts. Just as in farming every field requires separate study, so every village presents its own particular problem. But those who are grappling with a thousand local problems can bring to a common stock the experience which will help in the solution of all. It is our hope that the Rural Department of the Council of Social Service will form not only a clearing house for ideas, but also a real stimulus and present help to all those who are working for a fuller and brighter life in the villages of England's green and pleasant land.

* The Village Clubs Association and the National Federation of Women's Institutes, Sir H. Rew being Chairman of the Joint Committee of the two bodies.

VILLAGE INSTITUTES AS AN AID TO RURAL EDUCATION.

SOME instructive passages on the question of rural education in its relation to the development of village life are contained in a Report on the problem of adult education* issued by the Ministry of Reconstruction some months ago.

¶ The Committee considers that the improvement of the social and intellectual life of the village is essential for the maintenance of a vigorous rural population. In this respect the events of the last five years should have opened the way for reconstructive action. New circumstances have been created which offer better prospects of success in the immediate future. The soldier from the countryside has returned to his civilian duties influenced by the more varied social and educational opportunities—plays, concerts, lectures, study circles and classes—of military life, while those who remained on the land during the War have enjoyed a wider experience than was common in the past. Further, the growth of the Trade Union Movement and the establishment of the District Wages Committees have given the men new interests. Yet unless country life provides more avenues than are open at present for the employment of leisure time, it is certain that the drift to the towns, which was so noticeable in the past, will continue. In order to prevent this exodus to the towns the great need of the village is, in the Committee's opinion, the improvement of the social life of the countryside. The rural problem is essentially a problem of re-creating the rural community, of developing new social traditions and a new culture. What is needed is to establish in the village a living nucleus of communal activity which will serve as a centre for the satisfaction of the social and intellectual needs of the people. Such a nucleus the Committee conceives to be a Village Institute, under full public control.†

The Committee's idea of a fully-developed Village Institute is thus outlined in the Report :—

* Cmd. 322. 1919. Ministry of Reconstruction, Final Report of the Adult Education Committee. London : H.M. Stationery Office, 1s. 9d. net, excluding postage.

† The passage of the Report in which the Committee's views on this matter are expressed is quoted on p. 146. The article by Sir Henry Rew on "The Social Service in Rural Areas," which appears on p. 145 of this issue, should be read by all interested in the Village Institute as a means of improving rural conditions of life.

"The Institute should be the headquarters of organised local activities of all kinds. Trade union branches, friendly societies, pig clubs and bee clubs, and agricultural and horticultural societies of one sort and another, adult schools, and classes arranged by voluntary organisations, Women's Institutes, schools for mothers, chess clubs, and so forth, should be encouraged to use the Institutes; and one or more rooms, as may be necessary, should be provided for the purposes of their meetings. The Institute should contain a hall large enough for dances, cinema shows, concerts, plays, public lectures, and exhibitions. At the Institute there should be a public library and local museum. If arrangements can be made for games and sports, so much the better. The Institute, in a word, should be a centre of educational, social and recreational activity."

It has been pointed out in a Memorial to the Committee that the schools possess certain advantages for library accommodation, as the master is more or less in direct contact with the villagers, and the school children can readily carry the books home to their parents and relatives and also act as a medium of return. The school, however, may not always be the best depository for the periodical consignments of books to be brought from the general central library, and where Village Institutes and similar organisations exist the books may be better placed therein.

Accommodation.—Under present conditions these activities are carried on to a greater or less extent, but more often than not they are hampered partly by the lack of accommodation free from definitely sectarian or cramping philanthropic control, and partly by the unsuitability of such accommodation as exists. In the opinion of the Committee nothing short of a great national programme designed to provide in every parish an Institute suited to its needs will meet the requirements of the rural community in the near future.

Cost.—With regard to cost, it is suggested that the Institutes should be established out of public funds. The Committee states that the cost could not be borne by Parish Councils or even County Councils; it mentions also that the Institutes would be used more and more for public and quasi-public purposes.

A National Concern.—In the main, the Committee considers that the establishment of Village Institutes should be a national charge. Direct encouragement should be given to the estab-

lishment of a new communal organisation and to the development of corporate activities and social institutions in harmony with modern social ideas. The State cannot create a new social spirit ; it can but provide opportunities for its growth and expression. One of the chief of these opportunities is the Village Institute, and the Committee states that it can think of no more profound and far-reaching piece of rural reconstruction than the provision of buildings expressly designed as a focus of the social activities of village communities. Whether such Institutes become active centres of social and educational work will depend largely upon the degree to which voluntary organisations of various kinds co-operate in utilising the opportunities which the Institutes present. It is clear that a Village Institute can never become the mainspring of organised life unless the organised activities of the village centre in the Institute. The success of Village Institutes in the future rests upon an appeal to groups of people with common interests, rather than to individuals. It is because such groups have in recent years begun to flourish that the Committee looks forward hopefully to a vigorous life within the Village Institutes. It may well be that the Women's Institutes, which have taken root in rural districts during the past four years, should in many places provide the social stimulus and basis of social organisation necessary for these continuous and varied activities without which Village Institutes must become moribund.

State Aid.—The proposal of the Committee is that the State should make a grant-in-aid, as and when the demand arises, to Parish or Rural District Councils, through the County Councils, in respect of capital expenditure, amounting to 90 per cent. of the total cost. The remaining 10 per cent. should be raised locally. The total cost to the State of such a scheme for Great Britain might amount to £5,000,000, or even more. Once the Institutes were established, it should be possible for a Parish Council or Rural Council District, as the case may be, to maintain the activities carried on in them. In the case of societies using the rooms for meetings of classes, a small fee would be charged. Where concerts, plays, public lectures, cinemas, and exhibitions were arranged, they would be a source of income, whether they were initiated under the auspices of some voluntary organisation or movement or by the Parish or Rural District Council.

The Development of Educational Facilities.—The Committee makes a number of recommendations on the development of educational facilities in rural areas. It considers that educa-

tional work in the village should be put upon a permanent basis, so that in normal circumstances the village may never be without some form of serious intellectual activity adapted to the needs of the students as regards both subject-matter and methods of treatment. In arranging educational classes, the Committee thinks that it may be found necessary to devise a winter session, shorter than that which has been adopted in the towns, and the normal winter class might well be of twenty weeks' duration.

Classes.—The Committee is inclined to think that there should be some half-way house between the one-year class and the tutorial class meeting for three winters of twenty-four meetings each. A modified university tutorial class meeting for twenty weeks during two consecutive winters might be found to meet a real need in rural districts.

While it is important that study circles and classes should, as far as possible, be arranged in every village, such a network of activity would by no means fully meet the needs of rural areas. It is desirable that the market towns and larger villages should become the centres of educational activity and that classes, week-end conferences, exhibitions, and similar projects, should be arranged in them with the co-operation of the surrounding villages. It is in these rather larger centres of population that the Committee expects tutorial classes, or the modified form of tutorial classess suggested above, to be held. These centres would also meet the special needs of those for whom it is impracticable to make adequate provision in their own villages. The market towns and larger villages would naturally become the focus of the educational work carried on in the surrounding villages, and would provide the opportunity for that co-operation between various groups which the Committee regard as essential.

Importance of Association and Voluntary Organisation.—The Committee feels convinced that a rural educational movement would be short-lived, unless classes and groups of students were associated together in some way and imbued with a corporate spirit. It is desirable that voluntary organisations in rural areas should co-operate with a view to federating adult educational work within their districts.

It is proposed that "summer" schools and "summer" meetings, which have usually been carried on during the summer months, but which may be extended to the winter months, might form an integral part of the general educational scheme. Federated groups of students would make arrangements for

week-end lecture schools, but tutorial schools and "summer" schools might occasionally make their headquarters in a rural district, to the mutual advantage of both town and rural students.

Appointment of Educational Officers.—With the development of the work in rural areas it would become necessary to appoint resident organisers for the purpose of opening up new centres and carrying on the administrative work without which the various villages cannot be linked together. These organisers should be fully conversant with country life and rural needs, and, in view of the difficulty of obtaining teachers and lecturers, it would be advisable that they should be able to take part themselves, as far as circumstances allowed, in teaching work. The Committee does not, however, look upon this as a satisfactory solution. It considers that, just as in the case of towns, the development of a system of resident tutors and the decentralisation of university extra-mural education is desirable, and it therefore regards the gradual establishment of resident tutors and lecturers in rural areas as a necessary part of the general scheme of rural education.

LIMING IN HEREFORDSHIRE: ENCOURAGEMENT OF A LOCAL INDUSTRY.

JOHN PORTER, B.Sc., N.D.A., N.D.D.,

Organiser of Agricultural Education for Herefordshire.

FOR some years there have been indications that the soil of Herefordshire was becoming impoverished by the exhaustion of its lime constituents. The diminution of crop-yielding capacity became increasingly noticeable during the War, and such unsatisfactory returns were obtained that many farmers experienced difficulty in cultivating their land at a profit. Contributing factors to this exhaustion were the using up of lime by the natural development of acidity in the soil, the continued use of sulphate of ammonia and superphosphate, and the removal of lime from the soil by farm live stock and crops.

The Herefordshire Agricultural Education Sub-Committee therefore decided to investigate what steps might be taken to improve the situation. On behalf of the Committee the writer visited certain unsatisfactory cropping-land in the county, and found it to be covered with sheep's sorrel, spurrey and other plants which flourish on acid soils. Chemical tests were made, which showed that the soil was very deficient in lime.

Results of Liming Experiments.—The following experiment gives interesting data as to the value of lime on this sour soil, conducted on mangolds and swedes in order to test the effect of a "complete" mixture of artificial manures, both with and without lime. A field was selected for the purpose, and three plots were marked out and given a medium dressing of farmyard manure. One of the plots received in addition a dressing of artificials and lime, and one plot a dressing of artificials only. The lime was applied in the autumn at the rate of 30 cwt. of carefully slaked lump lime per acre, and the artificial manures were applied in the spring.

The two plots receiving artificial manures showed considerable improvement over the unlimed plot, but the improvement in the case of the plot receiving lime in addition to artificials gave much better results.

The yields per acre of roots at the close of the season were as follows :—

	<i>Mangolds.</i>		<i>Swedes.</i>	
	<i>Tons. cut.</i>		<i>Tons. cut.</i>	
No artificials	12	19	14	4
"Complete" artificials ..	19	0	19	6
"Complete" artificials and lime	23	17	23	0

These results are of great value in showing that land of this kind can benefit considerably by a dressing of lime in addition to artificial manure. There is no doubt that much land in the country is not yielding up to its fullest capacity owing to deficiency in lime, and needs treatment on similar lines.

Transport and Labour Difficulties.—Before the need for increased supplies of lime can be met two difficulties in regard to transport and labour have to be overcome, viz.—

(a) Ground lime has to be brought from 60 to 100 miles, *i.e.*, from Derbyshire or Somersetshire, by rail, with heavy railway expenses; alternatively

(b) The clot or lump lime, which is available in adjacent counties (*e.g.*, Radnorshire and Monmouthshire) can be transported to Herefordshire by rail at a smaller cost per ton, but as it has usually to be distributed by shovel it needs to be supplied at a much greater rate per acre than ground lime; hence there is no saving of expense.

In the face of the expense involved, farmers are naturally reluctant to purchase lime for their land.

Local Limestone.—Having regard to this fact, the Agricultural Education Sub-Committee considered the possibility of utilising the local supplies of limestone for agricultural purposes. These supplies consist of Silurian Limestone in the eastern and northern parts of the county, and Carboniferous Limestone in the south, while Cornstones occur in small quantities distributed throughout the Old Red Sandstone formation of the central and western parts of the county. With a little arrangement it should be possible largely to overcome the difficulties experienced in securing lime from a distance by developing local supplies, if only limestone of a satisfactory quality could be ensured and the amount available were sufficient to encourage enterprising firms to take up the matter.

Estimated Amount required for Agricultural Purposes.—It would seem that there is justification for anticipating a sufficient demand. There are approximately 150,000 acres of arable land in the county at present, which ought to receive a minimum dressing of, say, 2 tons of lump lime per acre (or 10 cwt. of ground lime at least once in eight years) On this basis, 37,500 tons of burnt lump lime (or, say, 10,000 tons of ground lime) would be required each year for liming arable land in the county.

The 295,000 acres of permanent pasture land in the county have not been taken into account in the above calculation. The lime removed by the continual grazing of the young cattle, sheep and horses, will, however, need to be returned to the soil in some form or other if the best results are to be obtained in the future.

In addition to the supplies which are needed for agricultural purposes, lime and limestone would be required for other industries, such as building and road construction. There is every reason, therefore, to believe that the demand would be large.

Quality of Local Limestones.—The next step of the Committee was to take samples of the limestone in the county for analysis, but a report was previously obtained from each County Councillor as to the location of any lime-kilns in the district which he represented. The County Councillors were also asked to state (1) the owner and occupier of the lime-kiln, (2) the length of time which had elapsed since the kiln was used, (3) whether there was an abundant supply of limestone available, etc.

From this information, a selection was made of the limestone quarries from which it was proposed to take samples. An effort was made in each case to get in touch with the local lime-burner, so as to ensure that samples should be obtained from the stratum of limestone most favoured for burning purposes. In the course of receiving these samples the immensely important practical point was revealed that the *grey crystalline limestones* of the Silurian formation which were most favoured for burning for lime are found nearer the surface of the quarry than the "dark grey" and "blue" limestones, which are more suitable for road-making purposes. The eighteen samples taken were then forwarded to Mr. John Hughes, F.I.C., County Analyst for Herefordshire, who reported as follows as to their quality :—

No. of Sample.	Name of Quarry.	Carbonate		
		Silica. Per cent.	Magnesia. Per cent.	of Lime. Per cent.
10.	Great Doward Whitestone Quarry	0.10	?	99.80
1.	Ledbury Hill (Greystone) ..	2.30	?	96.30
4.	Cradley (Shapland's) ..	3.40	?	94.30
2.	Ledbury Hill (Dark Grey-stone)	2.70	?	94.20
5.	Cradley (Lockyear's) ..	6.70	?	91.90
15.	St. Margarets (Whitehouse, "Woodfield")	5.25	?	91.69
9.	Hope Mansell (Silverstone Farm)	6.80	?	90.30

No. of Sample.	Name of Quarry.	Silica, Magnesia.		Carbonate
		Per cent.	Per cent.	of Lime. Per cent.
18.	Ross (Howle Hill)	9.00	?	89.10
16.	St. Margarets (Whitehouse, " Lime Kiln ") ..	9.20	?	88.00
6.	Mocktree (Grey Limestone)	8.80	?	85.50
7.	Mocktree (Blue Limestone)	12.70	?	85.10
17.	Grendon Bishop (Newbury)	11.10	1.08	84.44
13.	Mordiford (Little Hope)	15.70	?	81.40
14.	Fownhope (Rugend)	16.90	?	80.20
8.	Aymestrey (Pyon Wood)	17.65	?	79.20
3.	Ledbury (Bluestone)	19.30	?	75.90
12.	Drybrook	1.50	19.69	55.80
11.	Great Doward Hill (Black- stone)	2.40	20.23	54.30

The agricultural value of limestone depends upon its purity and richness in lime. The above results, therefore, indicate the respective value of the several samples. No. 10 is exceptionally rich, and Nos. 1, 4, 2, 5, 15, and 9 may be regarded as good agricultural limestones. Nos. 7, 17, 13, 14, 8 and 3 contain too much insoluble silicious matter to be useful for agricultural purposes, either in the form of ground limestone or caustic burnt lime. Nos. 12 and 11 are magnesian limestones frequently regarded as of inferior value, but, nevertheless, distinctly valuable for treating sour soils.

If ground into a fine powder the lime in samples 10 and 3—respectively the richest and poorest in lime—is completely dissolved in a very weak solution of citric acid (*i.e.*, 1 part citric acid in 1,000 parts water); if, therefore, the limestone could be reduced to a fine powder it would be admirably adapted to the Red Sandstone soils of Herefordshire.

Distribution of good Agricultural Limestone.—The above Report of the County Analyst is exceedingly valuable, and shows how fortunate the county is so far as the situation of good agricultural limestone is concerned.*

The soil east from Hereford is a stiff clay soil, which requires liberal dressings of burnt or caustic lime in order to bring the soil down into a nice friable condition. In this area excellent limestone quarries exist at Cradley and Ledbury, both well supplied with lime-kilns. Limestone burning was being carried on at Cradley at the time of sampling the stone, and Ledbury has since commenced the work.

South of Hereford the soil is a sandy loam, on which it is better to use lime in the mild or unburnt form. The large supply of a pure limestone on the top of Doward Hill is very valuable; all that is required for local use on the land is to

grind it down to a fine powder, without previously burning. For distribution, an enterprising firm could place storage bins at Symonds Yat Station, as well as at a convenient point at the bottom of the hill between Symonds Yat and Whitchurch, where it could be conveyed by road to different farms. These bins could easily be filled by trucks carried on an overhead railway from the point of quarrying and grinding the stone. It would also be a great advantage to have one or more steam lorries, so as to be able to deliver the ground limestone for the farmer.

The Golden Valley has a fairly good limestone and kilns close to Vowchurch, but the limestone quarries sampled in the north of the county have not proved so satisfactory. Fortunately this district has an excellent supply of lime in the New Radnor district.

The Agricultural Sub-Committee is giving all the publicity possible to the fact that suitable agricultural limestone exists in the county, and already its efforts are bearing fruit.

Co-operative Burning.—In the Aymestrey District the writer learnt that a small limestone quarry used to be worked for agricultural purposes by about half a dozen neighbouring farmers. Each farmer assisted with the quarrying of the limestone and the carting of the coal, and after burning received his share of the lime.

Dual Purpose Quarries.—The quarry at Ledbury Hill is an interesting case of a dual purpose quarry. It has been taken on lease by the Ledbury Rural District Council with the primary object of supplying stone for the roads. To reach the stratum containing the road stone however, it is necessary to cut through an upper stratum which, as already explained (p. 159), contains lime excellently suited for agricultural purposes. The quarry is thus worked with the double purpose of obtaining both kinds of limestone. This is certainly one of the most economical ways of working a quarry, and the system should be extended in rural districts where suitable limestone quarries are being worked by the County or District Councils.

FARM ACCOUNTS, PROFITS, AND COSTS.*

H. G. HOWELL, F.C.A.,

Director of Agricultural Costs, Agricultural Costings Committee.

FEW would deny that there is an urgent need for farm accounts to be kept on a much wider scale than hitherto. The industry as a whole has probably lost considerably both in money and efficiency by the prevailing neglect of farm book-keeping. There is on this subject a surprising unanimity in the reports of several Government Committees of Inquiry which have been instituted recently. Without exception they record the lack of information and urge the necessity for more and better account keeping.

It is not difficult to understand why farm book-keeping has been neglected in the past. The term book-keeping itself reeks of the town and the office and indoor work. The farming community has been proud of its isolation and distinctiveness from the town, and suspicious of all that is connoted by factories, ledgers and the like. It has maintained its high level of technical efficiency in the past without book-keeping assistance. The average farmer is an open-air man with a temperamental objection to account books, and with little time and less inclination to think about them.

This state of affairs, however, is an old and closed chapter. All the circumstances are altered. Farming has not escaped the rapid flux and change which has been observable for a number of years, and has been accelerated during the last five. The increasing cost of all farming expenses; the pressure of Income Tax Assessments; increasing competition; the development of transport, tending to bring town and country together—all of these combine to force the question of farm book-keeping to the front.

Kind of Accounts.—When speaking of farm accounts, I am not referring to the farmer's Bank Pass Book. If he is relying on that to know his financial position from time to time, he is unwise. The position disclosed by the Pass Book is too indefinite. Private transactions may be mixed up with those of the farm, obscuring the results; amounts owing to

*Resumé of an address delivered to the Agricultural Club, 80, Pall Mall, London, S.W. 1, at their meeting on the 11th February, 1920.

and by the farm are not taken into account, nor differences in the amount of the valuation at the beginning and end of the year.

Most of the above objections apply equally if the kind of account relied on is one of cash receipts and payments only, without a valuation and without regard to the amounts owing.

A simple method of book-keeping for small or medium-sized farms is to use a Cash Book with several analysis columns on either side, and a farm diary. This method will enable the farmer to keep the private transactions separate, to account for all the monies he receives, and to verify the correctness of his Cash Book with the Bank Pass Book. At the end of the year the totals of the various analysis columns of the cash book are the foundation of his annual statement of account, in which will be entered the amounts owing to and by the farm at the end of the year, and the amount of the Inventory and Valuation. This plan is the simplest that will give efficient results; in some cases, including the larger farms, more books will be necessary.

Advantages.—In all cases accounts are a valuable source of information, and in most cases they save money. One of the main objects in keeping accounts is that the farmer may know at regular intervals how he stands, and to what extent his farm is paying. Knowledge of the facts is the first step towards economy, and the proper control of expenses and of the whole financial side of the farm business.

The expenses of the farm can be divided into as many headings as is desired and a watch kept on each expense with a view to economy. The various sources of income can be similarly classified, and useful comparisons made from year to year.

Proper accounts will prevent the possibility of an account being paid twice; will save trouble with disputed accounts; and enable track to be kept of troublesome things such as sacks, over which a lot of money is lost every year. Further, if the farmer wishes to obtain a loan from his banker, it is more easily arranged if he can produce a proper statement of account—and other advantages ensue.

The strongest inducement to account keeping may be mentioned last, *i.e.*, liability for Income Tax Assessment. A farmer may now choose to be taxed on his profits instead of on the double rental, but in this event, he must produce accounts to the authorities. Though the great majority

of farmers at present pay Income Tax on the rental basis, an increasing number are finding it necessary to ascertain their profits or losses from year to year, in order to have the information available for Income Tax purposes if necessary.

FARM PROFITS.

General.—Although by no means the only object, one of the objects of keeping accounts is to ascertain the result of the year's operations in the way of profit or loss. It is often thought that once the accounts have been made up and a resulting figure shown of profit or loss, that figure is a matter of fact about which there can be no dispute or difference of opinion. This is not so. Profit in most, if not all, cases is much more a matter of estimate and opinion and valuation than a matter of fact. Before accepting as correct the amount of profit shown by any account, it is necessary to consider the various steps by which that profit has been arrived at, and the questions of valuation, apportionment and principle that have been dealt with in arriving at the profit.

There are many reasons which account for the difficulty in settling the real figure of profit in a given case, and some of these will be briefly considered.

I. Arbitrary Period.—The period for which accounts are usually made up—12 months—is quite an arbitrary one. We are compelled for various practical reasons to show the results of farm operations at regular yearly intervals. It becomes important for many reasons, amongst which are profit-sharing schemes and assessments for Income Tax, that the profit should be allocated as correctly as possible to its proper year, and many of the difficulties arise through the necessity of doing this.

Again, some of the profits or expenses cover more than one year. A case in point is the raising of cattle which are sold after, say, three years. If a profit eventually results on the sale, in what way should that profit be apportioned over the three years during which the stock was being raised? A valuation of the stock at market prices each year may or may not bring about this result, while if the stock is carried forward at cost price until sold, the whole of the profit will be shown in the third year.

An analogous case, on a larger scale, is that of a building contractor who contracts for a building, the erection of which will take three years. The practice in apportioning the profit

in these cases varies. Sometimes the work is carried forward at cost and no profit is shown in the accounts until the building is completed. Or, again, some proportion of the profit may be taken credit for in each of the three years of construction, according to the progress of the work. But any such anticipation of the final profit is generally made on a most conservative basis. The comparison with the farm cattle differs in this respect, viz., that the contractor knows the final price he will receive on completion of the work, while the farmer does not know how the markets will stand when his stock is ready for sale. There is consequently greater need for him to be cautious in taking credit for any intermediate profits.

Again, expenditure may be incurred, the beneficial results of which will last for more than one year, such as laying hedges or drainage work. This outlay in ordinary cases should be written off in instalments over the period receiving the benefit. The benefit of cleaning the land and applying manures lasts for more than one year, but if the rotation is steady and the same cultivation and manuring is followed, these matters will average out.

2. *Valuation.*—(a) *Introductory.*—As the farm is a going concern, there are at the end of any year a number of unfinished transactions. Many of the difficulties in arriving at a proper figure of profit would disappear if all the transactions had been completed and realised or paid in cash (say at the close of a farm tenancy). In practice this is impossible. All the operations of raising and selling the produce are going on continuously. The final results of these operations cannot be ascertained until they are realised in cash, and in the meantime they have to be valued, for the purpose of making up each annual account. This element of valuation is one of the chief factors involved, and there is wide scope, not only for differences of personal opinion, but also for different methods and principle to be applied in making the valuation.

(b) *Two Classes of Stock.*—The various items of live and dead stock that are the subject of valuation at the end of each year are not all of the same character, and are not meant to serve the same purpose in the farm economy. This may affect the basis on which the two classes of stock are brought into the Accounts. In general terms, two distinct classes of stock are generally included in the valuation, which may be termed "Fixed" and "Circulating."

(c) *Fixed.*—Machinery and implements, work horses, breeding stock, etc. These are not intended to be sold but to remain

on the farm as the means of production for that farm. They are to that extent fixed or permanent or capital assets, and in their present or equivalent form they must always be employed on the farm while its present system of farming is continued. They will be referred to as "fixed assets." They are the property *with* which the farm is carried on, and the essential point to remember is that they are retained for production purposes, and are not intended to be sold.

(d) *Circulating*.—The other class is represented by the crops and live stock held for sale, miscellaneous stores of fertilisers, feeding stuffs, etc., and tillages. These are primarily meant to be *sold* and are not intended to remain on the farm. Some of the crops may be sold, not as crops, but in the form of the live stock to which they have been fed.

The first class has already been termed the fixed asset, and these may be correspondingly termed the "floating" or "circulating" assets, in that they are always circulating, *i.e.*, when they are sold they are turned into cash—this cash in turn is used to purchase other live stock or to produce other crops and stock—these in turn will be again converted into cash, with which crops and stock will be again produced—and so the process continues during the whole tenancy.

(e) *Alternative Bases of Valuation*.—There are alternative bases on which the valuation may be taken, which need consideration.

All, or any, of the items in the valuation may be taken at cost price, or market price, or at something under market price, or at a fixed price, or on some other basis.

I will deal in detail with two of these—the Cost Basis, and the Market Basis.

(f) *Cost Basis*.—By this method all the live and dead stock is carried forward in the accounts at its cost price until it is disposed of. The profit on any sale does not therefore appear in the accounts until the sale occurs. Until that time the movements of the market, whether up or down, are ignored in the accounts. This method corresponds most closely to those adopted by industrial concerns. It avoids the difficulties which are apt to occur, when market prices of unsold stock are put into the accounts and the market falls before they are ready for sale. But whatever merits this cost basis may possess very few farmers are able to adopt it, as the necessary information as to the cost is not available.

(g) *Market Basis*.—This method is customary and in many ways convenient, especially when live stock is concerned, and it will probably remain the one most frequently adopted.

The effect of putting the market price of unsold produce into the accounts is that the produce is treated in effect as if it had been sold, and the accounts show the profit at the time the valuation is put in. The profit is thus anticipated before its actual realisation, and becomes for that year a paper profit. It is probable that some farmers have been paying Income Tax on profits which are not realised profits, but which arise from the upward movement of the market. Further, it is sometimes found in practice that owing, say to corn threshing out badly, or damage being done by rats, or other similar causes, the valuation price is not realised, and in that event a loss ensues which has to be borne by the following year's account. The probability of this is of course lessened when, as is often the case, the valuation is made in a prudent and conservative manner, and temporary or abnormal fluctuations are discounted.

It will be seen that, even with the circulating assets which are intended to be sold, the insertion in the accounts of the market value of unsold produce tends to obscure the profit which is eventually realised in cash.

But whatever reasons of practical convenience may support the valuation of the "circulating" assets at market prices, the position is not the same with the valuation of the "fixed" assets. Profits thus arising from the changing values of this fixed property are not only paper profits, but paper profits arising on fixed or capital assets which must remain on the farm. The earning efficiency of these assets is unaffected by market movements; they are kept on the farm to produce, the work-horses and implements producing the crops, the breeding stock their offspring—and the dairy herd also producing milk. This being so, their efficiency as producing instruments is the measure of their value to the farm as a going concern.

In the course of the proceedings of the present Royal Commission on Income Tax, reference was made to the fact of these changing "capital" values appearing as profits in farm accounts, and it was argued that it was therefore inequitable to assess farmers for Income Tax on the amount of the profits shown by the annual accounts, as they would thereby be paying tax not only on the true annual profits from the produce sold, but also on these capital profits, to which Income Tax was not meant to apply.

(b) *Yearly Tenancies.*—It must be borne in mind that in England, at all events, most farms are let on a yearly tenancy, and with the increasing frequency with which estates are being sold and the risk of a notice to quit, it may be necessary for the occupier at short notice to realise even what have been termed the fixed assets.

It may be argued that these reasons make it unwise to assume that the farm will continue as a going concern, and that these fixed assets should, therefore, be valued in the same way as the stock, etc., intended for sale. But if for the "Fixed" Stock, cost less depreciation be adhered to as the basis, there is not much risk of a loss ensuing on realisation. Further, the great majority of farms in the past have not been subjected to interruption of their tenancies, and, in view of the promised legislation to give farmers increased security of tenure, I think the general considerations put forward above may stand.

3. *Reserves.*—At the end of the year there may be liabilities and contingencies—such as bad debts, dilapidations, decreased fertility, etc., for which it may be necessary to provide by making a reserve against the year's profit.

The necessary amount of depreciation to be written off the Live and Dead Stock (if these are not the subjects of a valuation) has also to be decided, and in practice this is often an important question.

In commercial concerns these reserves are more numerous and important than in farming.

The amount of profit to be reserved for all these purposes is largely a matter of personal opinion and prudence, or it may be, of policy, and these reserves afford a ready means of putting by secret reserves of profit and reducing the amount of profit disclosed in the accounts.

4. *Improvement Outlay and Maintenance Outlay.*—It is sometimes difficult to decide whether expenditure is in the nature of improvements or additions, or is for maintenance only.

Outlay on additions and improvements is an addition to the capital value.

Outlay on maintenance and repairs is a recurring expense which must be included in the expenses for each annual account. The dividing line, however, between the two classes of outlay is not always distinct.

Implements of improved quality or type and consequently of greater cost may be bought to replace others worn out. This may be treated in one case as a mere expense of renewal,

to be included with the other annual expenses, while in another case the part of the increased cost arising from the better quality or improved type may be regarded as an addition to the capital value of the equipment.

Again, continued high farming would add to the value of the farm, though this increasing value would not be shown in the accounts, as each year's cost of cultivations, fertilisers, etc., would be treated as expenses of the year.

5. Household Transactions.—Another difficulty in arriving at the final figure of profit or loss on the farm is the dovetailing of the farm transactions with those of the household and the farmer personally, owing to the extent to which the farm is used and worked by the farmer and his family.

These transactions do not involve the payment of cash, but in order to obtain accurate profit results, some at least of them should be given effect to in the accounts. Certain farmers may also desire to include with the expenses interest on the capital employed on the farm, before striking the final figure of profit.

Private income and expenditure, received and paid in cash, should always be excluded from the farm Profit and Loss Account.

It will be seen that in settling the profits quite a number of questions of principle, as well as matters of valuation and estimate and personal opinion, have to be considered, and that consequently the determining of profits is a matter of real difficulty, which affords scope for wide variation of treatment and on which honest differences of opinion may exist without improper motives or ulterior objects being imputed.

FARM COSTS.

To distinguish these cost records from ordinary farm accounts, they may be defined as the detailed records showing the cost and result of each branch of the farm, as distinct from the ordinary farm financial account, which shows the profit or loss on the working of the farm as a whole.

The usual form of farm account does not show the profit or loss of each branch of the farm. Each item of expense appears in one total without showing which branch of the farm has received the benefit, and the final figure of profit is the over-all profit of the farm as a whole. This inclusive profit

generally conceals a loss (perhaps an expected and necessary loss) on one or more departments.

How to Obtain Cost Records.—One of the main objects of cost records is to show separately the cost, and profit or loss result, of each crop and class of stock, etc., and the records are obtained as follows:—

Part of the information from which these cost records may be prepared will already appear in the financial accounts, but some additional work is necessary.

1. The various expenses are split up and charged to the branch in respect of which they are incurred. Thus wages, according to its employment, will be apportioned to the various crops, live stock, etc.

2. Effect is also given to certain transactions that do not appear in the Cash Book. These are various "internal" transactions, not involving money payment, in respect of mutual services rendered by one branch of the farm to another, *e.g.*, home-grown crops fed to the stock, labour of work horses on the crops, manure produced by the live stock for use on the land, etc.

3. Certain of the expenses (*e.g.*, for cleaning land and for certain manures), the benefit of which extends over more than one year or crop, are divided over the various crops as accurately as possible, according to the benefit which each receives. Suitable forms are used to record these "internal" transactions, the most important of which are the daily employment of the labour, and the consumption of the farm produce by the stock.

In rough, broad outlines, this is how the cost of each crop and class of live stock is ascertained. The corresponding income of each branch is known and the difference is the profit or loss. The aggregate amount of these profits or losses should agree with the over-all profit in the financial accounts.

Farm cost records require care, and while the regular records to be kept through the year are fairly simple, the closing work to get at the final cost is more difficult. The natural harmony of the rotation introduces difficulties, as does the analysis of the "internal" transactions between the different branches and the rotation course, and questions of principle arise which affect the basis of the cost records.

It must be admitted that many farmers have not the requisite time or ability to keep costs without assistance. But if, as is

hoped, groups of farmers in the near future combine to employ a clerk or accountant to keep their records, this difficulty will be overcome.

Advantages.—To enable the farmer to apply his practical knowledge in the fullest and most efficient manner, he must have the relevant facts before him, from which to adapt and vary his policy to meet the constantly changing conditions of markets, prices, seasons, etc., within the limits of his rotation.

The essential advantage of farm costs is as a means of information; they are a means and not an end. There is no virtue in the figures unless they are used. Unless they are carefully studied and the information they contain is practically applied, they are of little use. They cannot take the place of practical farming knowledge, but they enable that knowledge to be applied to the farm more fully and accurately. They bring to light the detailed inner working of each branch of the farm.

So far from stereotyping any system of farm management, they should facilitate the most elastic methods and assist in obtaining full efficiency in all the operations, and they become of increasing value when several years' costs are available for comparison.

IMPRESSIONS OF A VISIT TO DENMARK IN 1919:*

SOME COMPARISONS WITH RURAL CONDITIONS IN WALES.

S. EMILY MATTHEWS,

*Late Organising Secretary of the Women's Branch of the Ministry,
Carnarvon and Anglesey Division.*

"To gather raw material for rural reconstruction" was the phrase in which Herr Lange, Principal of the Fyn Stifts Husmandsskole, described the object of our visit to Denmark. Perhaps it would be even truer to say that we went there to study Danish plans and methods of construction, and to try to understand how, from the ruins of the disastrous war with Germany, in 1864, the Danes have been able to build up a prosperous State. Of "raw material" we have as good in this country, but it is of interest to see how far the example of Denmark can be of help to us in this time of rural reconstruction.

The members of our delegation returned from Denmark with varied impressions of the agricultural methods and institutions of the country, but upon one thing we all agree—that there we found a healthy, thriving, and self-respecting rural population, making a livelihood out of the cultivation of the soil. The first thing which must strike anyone visiting Denmark is the number of clean, tidy homesteads per square mile which may be seen in every direction. My first thought, when viewing the country from the train which took us from Copenhagen to Ringsted, was—"here at any rate they grow men and women on the land"—surely the richest and most vital crop that any country can produce.

We subsequently visited many of these homesteads in various centres, and were treated most kindly by the people, who allowed us to see everything on their holdings—their cows, pigs, poultry, the crops, the farm buildings, even their kitchens and larders. What to me was more interesting than their methods or implements, however, was the fact that they and their families were able to live in comfort, if not in luxury, on the produce of 10 to 12 acres of land, and showed themselves quite happy and contented with their lot.

On one of the smallest holdings we visited, in the Island of Fyn (only 4 acres cultivated, mostly as a market garden, with a couple of cows, some poultry and pigs) the wife of the

* This article has been prepared by Miss Matthews as a result of observations made on a visit to Denmark with a delegation of women in June, 1919, with the object of studying Danish conditions in relation to women's work on the land at first hand.

holder showed us a family group in which she and her husband were seen seated amongst ten fine stalwart sons and daughters, who had all been born and bred on the holding.

The questions that were of greatest interest to me, during our brief stay, were : How is it that these men and women are contented and happy ? How is it that, though there are nowhere signs of great luxury on the one hand, there are nowhere signs of poverty or destitution on the other ?

The answer is not to be found in the richness of the soil. In the most fertile parts of Denmark there is nothing to compare with the land in the Vale of Clwyd and other Welsh valleys—indeed, there are large tracts that have only been reclaimed from barren heath or sand-dunes by the pluck and industry of the people. The climate of the country is rather worse than our own. Nor, do I think, is the answer to be found in the natural cleverness of the individual Danish farmer. Possibly the fact that agriculture is the chief industry of the country may partly account for its comparatively prosperous state, there being few manufacturing centres to which men are attracted by high wages. Still, such populous centres supply farmers in South Wales with a ready market for their produce at their very doors, whilst Denmark has to look across the North Sea for her market.

Causes of the Success of Danish Agriculture.—From what I could gather there are three outstanding factors which have made for rural development in Denmark, and have helped the Danes to realise the true meaning of "Back to the Land."

1. The most obvious factor is their *system of land tenure*—90 per cent. of the Danish farmers and small holders owning the land they farm. There is in most cases a mortgage, which is being paid off in yearly instalments over a long period,* but the owners feel a sense of security that the land is their own to make the best of, and to pass it on to their sons in better condition than they received it. They are free from the dread which has haunted many a Welsh farmer, that the rent may be raised on the tenant's improvements, or that the old home may be sold over his head.

The history of the dawn of land reform in Denmark, at the end of the 18th century, at the time when our common lands were being enclosed, and the struggle of the people for the freeing of the land during the latter half of the 19th century, would be interesting reading side by side with the history of Wales during the same period. The Danes, however, have travelled further than we have in many directions. They told

* See the issue of this *Journal* for February, 1920, p. 2061.

us "We are poor hands at revolution. We find our best way is to *prove* our rights. Thus in 1882, the only butter fit for export was that made on the big estates, and was sold for 1.42 kroner* per lb., while the inferior farm butter was sold for .88 kroner. Ten years later, after the farmers had learnt to co-operate, they were awarded all the gold and silver medals at the Dairy Show, while the estates only gained the bronze. We consider that our greatest political triumph." In the same way, the small holder tries to prove his equal right to existence by producing as good crops as the farmer.

On the larger farms we visited, which were not more than 100 acres, we found that the head man had a comfortable cottage with a neat garden, and enough land to keep a cow, some poultry and pigs. The other labourers employed were all young men up to the age of 25, putting in time and gaining more experience until they are able to acquire holdings of their own. There is thus no class of landless labourers, without prospect of anything better, or means of exit from a blind-alley profession. It is not, therefore, surprising to find that very little trouble occurs between employer and labour. These men usually "live in" as they do in Anglesey and other parts of Wales, but their quarters were neat and comfortable, comprising a sitting room in addition to their bedrooms. The wages, at the time of our visit, appeared to be very much the same as in this country.

The farm-houses are plain, mostly of the bungalow type, easily worked, fitted with electric light, and almost without exception with a telephone.

The surest proof that it is generally believed possible, in Denmark, to make a living out of 10 to 15 acres of land, is the ever increasing demand for small holdings. The demand is so great that the Bill before the Danish Parliament last summer was the third within the last 18 years having for its object the conversion of more precious acres into State small holdings.

2. The second factor is undoubtedly the wonderful system of *co-operation* in Denmark, which makes it possible for the small producer to make a living in competition with the larger farmer. The first co-operative dairy was started in 1882; there are now 1,188 such dairies in Denmark, with a membership of 157,000. The first bacon factory was started in 1887; there are now 41 societies, with a membership of 95,000. The most interesting fact in connection with these societies is that the movement was started entirely by the farmers themselves, and was not the work of organisers. It has proved so success-

* A kroner = 1s. 1½d., normal rate of exchange.

ful that the same principle of co-operation is applied to almost every branch of farming. We visited several dairies, egg-collecting stations, and a bacon factory. All produce is carefully graded, and great care is taken to maintain a high standard. We were told at the egg-collecting station that any member who has sent in an egg which is not fresh is warned after the first offence; for any subsequent offence he is fined 6s. per egg. Every pig brought to the bacon factory is examined by an expert, and must be absolutely free from any trace of disease, or it cannot receive the red export stamp. The Danes are careful to study their market, and to produce articles for which there is the greatest demand. For instance, we found that pigs intended for England were reared and fed quite differently from those intended for Germany. We were told, "You do not like your bacon so fat as the Germans do."

One effect of the co-operative movement has been materially to relieve the strain upon those who are the most overworked members of a farmer's household in this country, namely, the womenfolk.

The question occurred to me: "Why has not this same system been more generally adopted in Wales?" Those who have started cheese factories and egg or vegetable collecting stations know the up-hill work that is necessary and the prejudice, jealousy, and ignorance that have to be fought and overcome before these societies can flourish.

3. In the opinion of the most intelligent men we met, it is the third factor, the *Folk High Schools*, which has made co-operation possible, by widening the outlook of the peasants and giving them a sense of comradeship and mutual trust.

The Danes and the Welsh have two traits in common—they are characterised by an intense love for their country, and among all classes is found a passion for education and culture. We in Wales are proud of our intermediate schools and University Colleges, which have been built by the efforts of the people themselves—miners, quarrymen and labourers all contributing their bit. What has been the idea behind it all? Has not the labourer looked for some door through which his son, if intelligent, may escape from the land and take up some other profession? The boys and girls from our intermediate schools and colleges do not often return home feeling that it is a fine thing to till the soil. In Denmark, in addition to secondary schools and colleges for those who wish to take up a scholastic career, they have a quite different type of schools, the *Folk High Schools*, and their offspring, the schools for small holders. These schools provide three or five months' courses

for those, who, having left school at the age of 14 or 15, and having lived at home for four or five years, helping on the farm, have come to feel that they want further instruction and inspiration.

In order thoroughly to understand these schools, we must go back to the history of their inception and the ideals of their founder, Bishop Grundtvig, who lived in the early part of the 19th century. His ideal was the establishment of a truly national school, which would arouse in the students a wish to make their country a good country, not only for the individual, but for all Danes. His theory was first put into practice in 1850, but it was not until 20 years later that the Folk High Schools took their hold upon the nation.

The main principles which Grundtvig laid down were :—

1. That the schools should be for adults, no one to be admitted under the age of 18
2. That the pupils should live together at the schools for the few months they attend the course, thus acquiring a sense of unity and mutual trust.
3. That they should be taught by the "living word," that is, words of deep conviction, from the heart, and having an influence on the lives of others no mere book learning, and no examinations.
4. That the chief subject taught should be the history of the development of Denmark, and the building up of the life of the nation, linked up with the history of the peoples of the world
5. That the attendance should not be compulsory nor entirely free

There are now over 80 high schools, a number of agricultural schools and 3 schools for small holders. In all cases they have been founded by private or co-operative enterprise, and must be able to show two years' successful working before an application for State grants will be considered. Scholarships, covering three-fifths of the cost of the course, may be obtained, the students being allowed free choice of any school in the kingdom, and not restricted to those in their own district or county. This, we were told, has a very healthy effect on the schools, as under this system an unsatisfactory school dies a natural death for lack of pupils, and the best schools grow rapidly.

During our stay in Denmark, we visited several Folk High Schools, and agricultural schools, and stayed at two schools for small holders, where cultural subjects are taught along with the practical and more technical subjects. While at these schools we tried to live the life of the students, and to get as far as possible their point of view. We were there during the summer months when the course is for young women—the

men attend during the winter. The first lecture, at 8 a.m., was either Danish literature or history, followed during the day by lectures on hygiene, food values, the planning of the home, the best way to lay out the garden, and the history of the development of the land laws, and of the struggles through which the privileges they now enjoy had been won. During the morning they split up into companies, taking, in rotation, practical cookery, dressmaking, embroidery, gardening and poultry-keeping. The cookery lessons teach the best use of such food as can be produced on a small holding. An hour is devoted to gymnasium every afternoon, and after supper the day is concluded with singing, or, when the weather is fine, with games and country dances in an open space in the grounds, in the centre of which is a tree planted to commemorate the granting of suffrage to Danish women.

In addition to the summer and winter courses for young men and women, special eleven-day courses are arranged for small holders and their wives. Practical demonstrations are given, and the lectures are made as simple as possible. The meaning and effect of newly-made laws, and the contents of reports of experimental farms and official publications are explained in a clear and concise way, so that considerable time and labour of reading are saved to the small holder.

We asked the sons and daughters at most of the farms we visited what high school they had attended, and in no case were we told they had not been to one.

The aim of these schools is not to turn out scholars (for advanced scientific courses agricultural students must go to the colleges), but rather to help the ordinary people in their everyday life, and to make them better citizens. The chief object of the instruction appears to be the building up of the rural home life, to give those who live in country districts a wider outlook, and to remove prejudice and mutual distrust. The students return home with fresh inspiration for their daily tasks, and instead of regarding the country as "dull," as many of our young people do, they find their work full of interest, and are determined to overcome difficulties and to make the best of their few precious acres.

They also take a greater interest in the communal life of their native village, and start gymnastic clubs, literary and debating societies, and choral unions. In fact, these schools supply to the national life of Denmark the same element as the Eisteddfod does in Wales; they are animated by the same spirit, and are, at the same time, an inspiration and an expression of the soul of the people.

THE MANAGEMENT OF BULLS.

THE following notes on the care and treatment of a bull have been prepared as a guide to farmers who have had little or no experience of keeping a high-class sire, and especially for those who are custodians of bulls under the Live Stock Scheme of the Ministry.

The bull has been said to be "half the herd." If he is to get strong, healthy calves and prove a good investment he should receive better treatment and attention than the ordinary stock on the farm.

Many bulls are housed and specially fattened for sale, and when such animals are purchased it is advisable that they should be rested and carefully fed for the first few days after arrival, until they have recovered from the effects of the journey and have grown accustomed to a new attendant and a change of diet. During this period sweet hay, linseed cake, and bran are recommended as suitable food for a bull, but after about one week he should be gradually accustomed to whatever food it is intended to give him. Over-feeding a newly-purchased bull with too much concentrated food, or under-feeding with the idea of reducing his condition, are equally dangerous.

Feeding.—The idea that bulls will prove unfertile or lazy unless they are kept in lean condition is entirely wrong. To obtain strong, healthy calves it is necessary that the bull used should be in good condition and that he should be allowed plenty of exercise.

From 4 to 6 lb. per day, according to age, of cake or other suitable concentrated food is none too much to give a bull in addition to a fair allowance of roots and plenty of hay in the late autumn, winter and early spring, and of cut grass or other green food during the remainder of the year.

Regularity in feeding is most important. The times when a bull is to be fed should be fixed by the owner and strictly adhered to.

Before feeding an animal it is important to remove any food which may remain from the previous meal, and, as far as possible, an animal should not be given more at one meal than he is able to "clean up." The bull should always have free access to clean, fresh water. Where this is not possible he should be offered water twice daily.

The Attendant.—Bulls should be fed, attended to and exercised by a careful man; they should be treated kindly and on no account should they be teased, or they may develop vicious habits.

Every bull exceeding one year old should have a ring in his nose, and, for leading, a strong staff of an approved pattern should be used.

The hoofs should be kept short and the soles flat, either by exercise on a hard road or by paring them with a suitable instrument, otherwise the animal cannot stand, walk or serve properly.

It is advisable to brush and groom the bull regularly, and an occasional wash with soap and water is beneficial, to prevent vermin. Should vermin appear the animal should be twice washed with water to which a suitable disinfectant has been added. The second wash should follow the first after an interval of a week. A wineglassful of "Jeyes" fluid to a gallon of water is a suitable solution for the purpose.

Housing.—The bull should have proper shelter from the cold in winter and from the heat in summer.

To secure this it is advisable to keep him in a loose box (about 12 ft. by 12 ft. in size) well lighted and ventilated, but not draughty, attached to which should be an open yard, about twice the dimensions of the loose box, to which the bull should have access. The floor of the loose box and yard should be paved. Every morning the dung and soiled litter should be removed from the box, fresh litter supplied and the open yard swept clean.

Although on many farms a loose box and open yard as described are not available, it is generally possible to find a loose box in which a bull can be kept. On no account should a bull spend his life tied up by the neck and cramped in a stall which is often dark and dirty.

Exercise.—Plenty of exercise helps to maintain health and vigour. During winter, or when confined to the house, bulls should be led out for regular exercise: about one mile every other day is recommended.

In summer a run in a paddock may be permitted at night.

Service of Cows.—The practice of turning a bull loose among a herd of cows is not to be recommended. This often leads to him serving a cow repeatedly until both bull and cow are exhausted, and there is a danger of the bull becoming unfruitful and of the cow not proving in calf.

If a cow is in proper season one thorough service is all that is necessary. Double service should not be allowed: it is apt to reduce the constitution and condition of the bull, and it tends to diminish the number of cows he can effectively serve in one season and to shorten the period during which he is suitable for stock purposes.

Care should be taken that a young bull does not serve too many cows during a short period, especially when first used for service, or he will become stunted and lose his vigour, and possibly become temporarily or perhaps permanently unfruitful.

Prevention of Abortion.—There is a danger of bulls being the means of spreading abortion, and owners should therefore enforce strict adherence to the Regulations of the Ministry as set out in the Model Rules for a Bull Society (L²), which are framed to prevent the spread of this disease.

(This Article is also issued by the Ministry as Leaflet No. 342.)

AGRICULTURE ABROAD.

"FARMERS' WEEK" IN MISSOURI—AGRICULTURAL EDUCATION
IN CANADA—AGRICULTURAL CREDIT IN ALSACE-LORRAINE.

In January last a somewhat novel agricultural function, styled by its promoters "The Farmers' Week," was arranged to be held at the University of Missouri in America. The arrangements were planned by the University and the State Board of Agriculture, with the co-operation of the agricultural associations, and the object was to bring together the farming community of the State with a view to assisting in the spread of a knowledge of farm husbandry, and to give farmers an opportunity of discussing among themselves, and generally widening their outlook upon, matters connected with their industry. The primary object of the "Farmers' Week" was educational, but the social and recreative side received a large share of attention. The main features of this gathering were outlined in a programme issued by the University, extending an open invitation to all farmers of the State.

It was stated in the programme that farmers were to be allowed full facilities for inspecting the college equipment, laboratories, libraries, and classrooms, and the college staff and students would be available to lend their assistance in helping the farmers in every way possible. Nine special short courses of lectures were arranged daily under the direction of the University College of Agriculture, and included such subjects as live stock, dairying, poultry, horticulture, bee-keeping, soils and crops, and farm and home economics. Agricultural association meetings and a general Rural Life Conference were also to be held every day. The annual State Corn and Grain Show and the University Live Stock Show were special features of the programme. An Information Booth was to be erected on the premises, and farmers were requested to register at this booth on their first arrival at the University grounds, and receive the official badge. A publication entitled *The Daily Announcer* was to be distributed from this booth every afternoon.

With regard to the social side, entertainments were arranged as a regular evening feature, and contests, games, instruction and entertainments were provided for the boys and girls. A special programme was drawn up for farm women. To con-

clude the proceedings a farmers' banquet was arranged for the last evening, given by the University to visiting farmers.

In arranging such a social function as the "Farmers' Week" the agricultural authorities of Missouri have certainly taken a practical step in fostering the farm interests of the State. The idea might well commend itself to those at home interested in the development of agriculture by increased social intercourse.

* * * * *

THE place of the agricultural college and its importance to the future in promoting the interests of agriculture in Canada was the subject

Agricultural Education in Canada. of a series of articles in the issue of the *Agricultural Gazette of Canada* for

January last. Emphasis was laid on the importance of specialised education as a means of developing the industry, and of the responsibility resting upon the colleges for equipping their students with a training that will enable these men to take a place in the foremost ranks of human progress and achievement. It is expected that these institutions will not only fit men for farm callings, and turn out teachers, administrators and highly-trained investigators, but that they will instruct their students in the social sciences as applied to agriculture in order to qualify them to give instruction on questions of this character. Briefly, it is recognised that their function is to prepare young men both for vocational agriculture and for the proper discharge of their duties as citizens.

From Ontario westward, every province of the Dominion has now an agricultural college, established and maintained at the public expense, for the purpose of preparing men to become either practical and scientific farmers, or instructors, investigators and leaders in all matters connected with agriculture.

In the east of Canada a similar service is being rendered by the Macdonald College, an institution established as a private bequest, but receiving aid from the public treasury, and by the Agricultural College at Truro, Nova Scotia, the latter serving the needs of the Maritime Provinces. Quebec province has, in addition, two institutions designed to afford instruction in agriculture to French-speaking Canadians.

Agricultural education in Canada received a stimulus in 1912, in the passing of the Agricultural Aid Act. This measure placed moneys at the disposal of the provinces for the benefit of agriculture. It had been felt that a portion of the fund

should be devoted to increasing the efficiency of the agricultural colleges, and certain allocations were accordingly made under the Act for this purpose. In each province except Saskatchewan this preliminary grant was devoted to building, extension and improvement of the colleges.

In 1913-14 the original Act was superseded by the Agricultural Instruction Act. The policy of assisting the agricultural colleges has been continued, and a number of colleges and schools have been erected in the various provinces participating under the new Act. Since the passing of the Agricultural Instruction Act a total sum of \$1,890,143 (£393,780 at normal rate of exchange) has been allotted to the colleges and schools of these provinces.

* * * * *

A REVIEW was published in the *International Review of Agricultural Economics* for March last of a note communicated

by M. A. Laugel to the annual general
meeting of the Société d'Economie Sociale

**Agricultural Credit
in Alsace-Lorraine.**

on the subject of co-operative credit in Alsace-Lorraine. The information it contains furnishes an interesting example of the system of agricultural banks which has become popular in certain parts of the Continent to provide credit facilities to deserving rural workers who may be handicapped in their farming operations owing to lack of capital.

About the year 1880, it was decided to establish an agricultural credit bank of the Raiffeisen type in Alsace-Lorraine. The object of these banks, as is generally known, is to encourage the wealthier section of the rural population to place money on loan on good security, for the use of farm workers who may be in need of temporary financial assistance, to enable them to extend their farming operations.

Very satisfactory results attended the first years of the movement. Country districts were able to free themselves from the practices of usury which had been preying on them, and the system of credit was placed on a more healthy basis. The Raiffeisen banks were unlimited societies, and their members had thus an interest in watching the progress of their business and trusting only in men on whom they could rely.

With the development of this system of credit, federations of banks were formed which grouped themselves into larger units. Just as in the initial stages of the movement the more wealthy villagers lent money to the poorer inhabitants, so it gradually became the practice for the banks with the largest

resources to make advances to the smaller banks. Such transactions were carried out through the medium of a central agency, which received and distributed surplus funds. This agency also possessed the right to decide the use to which the money should be put.

The organisation spread through Germany, and eventually was divided, in every German state, into two distinct, but closely united, sections. The first section comprised departments of inspection, auditing, advertisement and technical instruction, and aimed at spreading among agriculturists a knowledge of the principles of farm husbandry.

The second section dealt with questions of finance. It served the purpose of a large bank, in which were centralised the funds of the subsidiary banks. In addition to arranging credit facilities, it also carried on an important trade in machinery, manures and supplies of all kinds, which were bought wholesale, and could, therefore, be resold on the best possible terms.

The extent to which Raiffeisen Banks have developed in Alsace-Lorraine is well shown in the fact that there are now over 470 of such banks in the country.

Another institution was set up by the Government of Alsace-Lorraine some thirteen years ago, owing to special circumstances, to compete with the Raiffeisen Banks. It was formed on much the same model as the Raiffeisen Banks, and, as in the case of these banks, was divided into two sections. By the assistance of the Government the new institution has prospered, side by side with the Raiffeisen Banks. Its organisation now includes 228 savings and loan banks, and some 60 miscellaneous associations engaged in agricultural work, and according to the balance sheet for 1917 it has collected about 26 million francs (normally more than £1,000,000), which are invested in loans to communes or in movable property.

QUESTIONS IN PARLIAMENT.

Home-grown Wheat.—In reply to a question by Captain Terrell, the Parliamentary Secretary to the Ministry stated the method by which it was proposed that the price to be paid for home-grown wheat harvested in 1920 should be ascertained.

The price to be paid for British wheat of sound milling quality would be announced each month, and would be the average of the c.i.f. cost of all milling wheat imported during the two preceding months, and of the actual and anticipated arrivals in the United Kingdom during the current month, subject to an adjustment in respect of the lower percentage of flour of equal water content obtainable from home-grown wheat as compared with imported wheat, and subject also to a maximum of 95s. a quarter. Home-grown wheat of sound milling quality would be defined as wheat of fair average quality for the season fit for milling into flour for human consumption.

In reply to the specific inquiries in the question, the term "similar or comparable quality" refers to the percentage of flour obtainable, and the prices would be adjusted accordingly. Consequently, in view of the fact that British wheat yields on the average a somewhat lower percentage of flour of equal water content than imported wheat, the maximum price of 95s. would be payable for British wheat so long as the average price of imported wheat was in excess of that figure. (19th April, 1920.)

Wheat Prices.—In reply to a question by Mr. H. Gritten, the Parliamentary Secretary to the Ministry stated that the average c.i.f. cost of all wheat imported during the financial year ended 31st March last was 94s. per 480 lb. The estimated average c.i.f. cost for the current month (*i.e.* April) is 104s. per qr. of 480 lb. The estimate for the bread subsidy for the current financial year recently submitted was £45,000,000. So long as the bread subsidy continues it was impossible to decontrol wheat, but it had already been announced* that higher prices would be paid to farmers for home-grown wheat harvested in 1920 and 1921. (22nd April, 1920.)

Spring Wheat.—In reply to a question by Capt. Terrell, the Parliamentary Secretary to the Ministry stated that no definite information was available in regard to the area sown with spring wheat, but from reports received the total area under wheat this year was considerably less than in 1919 and 1918. (13th April, 1920.)

Agricultural Bill.—In reply to a question by Captain Terrell, the Parliamentary Secretary to the Ministry stated that he was aware that the agricultural industry was anxiously awaiting the introduction of the Agricultural Bill, and the Ministry had received a number of resolutions on the subject from local branches of the National Farmers' Union and other bodies. He hoped, however, to be in a position to introduce the Bill at an early date. The reasons for the delay were the necessary reconsideration of certain aspects of some of the Clauses of what was a somewhat complicated and technical Bill. (22nd April, 1920.)

* See this *Journal*, March, 1920, p. 1153.

Land Settlement.—In reply to a question by Captain Coote, the Parliamentary Secretary to the Ministry stated that the number of men settled on the land in England and Wales under the Land Settlement (Facilities) Act, 1919, was as follow :—

Number of men actually settled (civilians and ex-service men)	5,794 on 79,631 acres.
Total acreage acquired, or agreed to be acquired, by the County Councils with the Ministry's approval	187,590 acres.
Average cost of land per acre	£41 4s.
Number of applications outstanding (ex-service men and civilians) :—	
Approved and awaiting land	20,060
Waiting interview, and standing over	10,890
	<hr/> 30,950

Loans guaranteed (figures only available up to 31st December, 1919) 10 for a total of £1,575.

He added that full information had not yet been received from the Councils as to the terms (including rent) on which the holdings had been let to those men already in occupation. Moreover, certain questions of equipment were still outstanding, and it was, therefore, not possible at present to supply precise information.

He further stated that in addition to this the Ministry had acquired 28,294 acres for the purposes of farm settlements, and that out of a total of 1,891 applicants, 697 had been approved, and of these 511 men were already settled. Forty-eight applicants were awaiting interview. The remaining applications had either been withdrawn or rejected. (19th April, 1920.)

The Titchfield Farm Settlement.—In reply to a question by Mr. R. Young regarding the Titchfield Farm Settlement, the Parliamentary Secretary to the Ministry stated that the area of this Settlement was 1,392 acres, and that the purchase price was £55,800. At present 230 acres were let to 76 ex-service men, the rent being £4 per acre for the first year and £5 per acre subsequently. The rents paid by small holders previous to the property being purchased by the Ministry varied in amount, but averaged about £3 per acre. This rent was paid for the bare land which the tenants had themselves to clear and get into good order. The Ministry was getting the land into thoroughly good order before letting it, and was also providing facilities for the hire of horses, implements, etc. Demonstration plots were also being established. In view of these advantages and the increased rate of interest now existing, it had been found necessary to fix a higher standard of rent. (14th April, 1920.)

Agricultural Wages.—In reply to a question by Captain Fitzroy, the Parliamentary Secretary to the Ministry stated that the impending rise in wages of 4s. was anticipated and taken into account when the recent announcement with regard to wheat prices was made. If it should become necessary to revise these prices in the future, due consideration would be given to any variations in the cost of production. (19th April, 1920.)

County Agricultural Committees.—In reply to a question by Captain Coote, the Parliamentary Secretary to the Ministry stated that schemes for the formation of County Agricultural Committees had been received,

some in draft, in the case of 46 County Councils up to the present. Fourteen had been finally approved, and in one case the Committee was complete and were to hold its first meeting this week. In 13 cases the appointment of the committee was still proceeding. In the case of the remaining 32 schemes, 21 have been provisionally approved and 11 were now under consideration. In the case of 16 Councils, no scheme had yet been submitted. (19th April, 1920.)

Grading of Hay.—In reply to a question by Sir H. Nield, as to the grading of hay by the Government, the Secretary of State for War stated that the grading of hay by the Government ceased with the purchase of the 1918 crop. The grading was carried out by officers of the Forage Department and by duly appointed buyers from the hay trade whose names were recommended by the Civil Supplies Central Council. He was informed that, as far as was known, there had been no complaints as to the grading. (16th April, 1920.)

Forage County Distributing Committee.—In reply to a question by Captain Terrell, the Parliamentary and Financial Secretary to the War Office stated that the distribution of the 1918 crop of hay and straw was dealt with by the County Distributing (Forage) Committees, and they were at present carrying out duties only in so far as the winding up of the organisation is concerned. (15th April, 1920.)

Agricultural Rates Act.—In reply to a question by Mr. Cautley, the Minister of Health (Dr. Addison) stated that the present amount of the annual grant to be paid into the Local Taxation Account under the provisions of the Agricultural Rates Act, 1896, is £1,323,827: in 1897, the amount was certified at £1,331,034. The total amount of rates, to which the Act applies, collected in respect of the year ended March, 1897, for the spending authorities referred to in the Act was £20,800,000. The corresponding figure for 1917 (the latest year for which the returns are complete) was approximately £47,800,000. Only a small proportion of the total relates to agricultural land. (29th March, 1920.)

Agricultural Machinery.—In reply to a question by Major J. Edwards, the Parliamentary Secretary to the Ministry stated that the recommendations of the Committee on Agricultural Machinery were now under consideration by the Ministry. The Ministry hoped to be able to obtain financial sanction for early action on certain of the proposals. No legislation would be required to give effect to the recommendations. (21st April, 1920.)

Foot-and-Mouth Disease.—In reply to a question by Captain Terrell, the Parliamentary Secretary to the Ministry stated that according to the latest information in the possession of the Ministry there was reason to believe that Foot-and-Mouth Disease existed or had recently existed in every country of Europe, with the probable exceptions of Norway, Sweden and Denmark. Many of the returns were, however, not of recent date, and no records of any kind were available in the case of Russia and 9 other European countries. In spite of every inquiry the origin of disease in the recent outbreaks remained obscure.

A Committee of Scientists has recently been appointed to investigate this disease, and it is hoped that its researches will commence shortly. (21st April, 1920.)

NOTICES OF BOOKS.

Flax Culture and Preparation.—Professor F. Bradbury (London: Sir Isaac Pitman & Sons, Ltd., 1920, 9s. net). This book has been prepared with the object of supplying information on the cultivation of flax for fibre and the subsequent processes of handling the harvested crop for use for textile purposes. It is styled "A concise and complete description of the process of flax cultivation from the selection of seed to the preparation of flax for the market." In the opening chapters the characteristics and composition of flax fibre are stated, and information given as to the germination, weight and purity of the seed, methods of testing seed for weight, moisture, and moisture in hot air, and various sources from which seed is obtained from abroad, including Russia and Holland. Following on the principal considerations in the selection of seed the questions of climate and soil, and manures most suitable to the growth of the crop, are discussed. Chapters are then devoted to the preparation of the land, sowing, weeds and weeding, harvesting, and saving the flax seed. The remainder of the book deals with the operations of deseeding, retting and scutching the flax. To those interested in the question of marketing flax the concluding short chapter on the system of weights and money values in foreign flax-producing countries may be useful. The volume, of 154 pages, contains a number of illustrations, both in the text and in the form of plates.

Co-operation in Denmark.—L. Smith-Gordon and C. O'Brien (Manchester: Co-operative Union, Ltd., 1919, 2s. 6d.). This volume is one of a series of books, each dealing with co-operation in a particular country, issued by the Publications Department of the Co-operative Union. The present volume contains a description of the origin, growth, organisation and results of co-operation in Denmark. In that country, as is well known, co-operation is the foundation of national prosperity. Agriculture, the chief industry, is co-operatively organised from beginning to end, and in the towns, as in the villages, the co-operative spirit finds expression in a variety of ways. Danish co-operative creameries and credit banks have served as models to be copied by agriculturists in other countries, and the book shows that the value of the contribution made to co-operative thought by Danish co-operators is very great.

First Report of the Departmental Committee on the Wholesale Food Markets of London (Cmd. 634. London: H.M. Stationery Office, 1920, price 1d. net). This Committee was appointed by the Food Controller to consider and report whether the existing wholesale markets for food in London were adequate, economical in their working, and efficient in their administration; to consider the influence of wholesale market facilities on food prices; and to report what steps, if any, could usefully be taken in order to effect an improvement in the wholesale distribution of food by means of public markets. The evidence received indicated to the Committee that, in the case of some of the markets, improvements and extensions were urgently required which could not be carried out under their present ownership and management, and that in the case of other markets the question of removal ought at once to be considered. The Committee therefore felt it desirable to present an Interim Report in order that this matter might receive early consideration.

The recommendation of the Committee, with the exception of one member, are :—

- (a) that market facilities ought to be administered not in the interest of private owners or of separate Local Authorities, but in the public interest.
- (b) that full legal powers and full financial resources should be made available for that purpose.
- (c) that the administration of these powers should be vested in one Central Authority for the whole of Greater London.

This Central Authority should have power, *inter alia*, to acquire compulsorily land and other property ; to raise funds necessary for the purchase of existing interests, or for the establishment of new markets to close existing markets, or to remove them to more suitable sites, and to make provision for any questions of compensation that may arise in connection therewith ; to fix tolls, rents and other charges payable by users of the markets ; and to erect and maintain any subsidiary buildings or undertakings for the benefit of such markets, such as cold storage, or other warehouse accommodation, and plant and equipment for the manufacture of ice, and the utilisation of market refuse, waste material, etc.

It is recommended that (c) should be adopted without delay, and that a Market Authority covering approximately the area known as Greater London should be established to exercise the powers and functions outlined.

An appendix is added to the Report, giving a list of wholesale food markets in London.

Report of the Tropical Agricultural College Committee.—Cmd. 562 (London : H.M. Stationery Office, 1920, 2d. net). This Report contains the findings of the Committee appointed by the Secretary of State for the Colonies in August last to consider the desirability of establishing a Tropical Agricultural College in the British West Indies. The Committee was unanimously of opinion that steps should be taken to found a Tropical Agricultural College in the British West Indies, and recommends, after giving careful consideration to the question of locality, that it should be established at Trinidad.

In the opinion of the Committee there is a great need in the West Indies for scientific investigators and advisers, and also of a body of British expert agriculturists well versed in a knowledge of the cultivation of land in the tropics, to develop the resources of the Islands. It lays emphasis on the view that the establishment of such a College is a matter of Imperial concern.

It is recommended that the staff of the College should include teachers with the status of Professors in the subjects of general agriculture, mycology, entomology, agricultural chemistry, organic chemistry, agricultural bacteriology, agricultural and physiological botany, genetics, sugar technology, and agricultural engineering and physics, and teachers with the status of Lecturers in stock and veterinary science and book-keeping.

The Report contains a number of recommendations as to the type of College needed and other matters included in the terms of reference.

MANURIAL VALUES OF

CORRESPONDENTS frequently ask for information as to the manurial farmers may have such information available for easy reference the No. 73 of the University of Leeds and the Yorkshire Council for Agriculture and Voelcker's Tables have already been published in this

MANURIAL INGREDIENTS.										
Food.	PER TON.			PER CENT.			Estimated Value of Manure produced by Consumption of One Ton of the Food (allowing half the Nitrogen, and three-quarters each of the Phosphoric Acid, and Potash). (Hall & Voelcker's Method)	£ s. d.		
	Nitrogen.*	Phos- phoric Acid† (P ₂ O ₅).	Potash (K ₂ O).	Lime. CaO.	Nitrogen.*	Phos- phoric Acid† (P ₂ O ₅).			Potash (K ₂ O).	Lime (CaO).
Cottonseed Cake—Decorticated	135	70	36	7	6.9	3.1	1.6	1.3	2 13 3	
" " Undecorticated	83	56	36	7	3.7	2.5	1.6	1.3	1 12 7	
Linseed Cake	106	38	29	9	4.7	1.7	1.3	1.4	1 16 0	
Hemp Seed Cake	100	56	31	9	4.5	2.5	1.4	1.7	2 2 0	
Rape Cake	112	45	29	15	5.6	2.0	1.3	1.2	2 12 6	
Earlgrain Cake, Decorticated	168	29	33	4	7.5	1.3	1.5	1.2	1 14 4	
" " Undecorticated	107	22	25	11	4.8	1.0	1.1	1.3	1 9 10	
Coconut (Copra) Cake	76	33	44	7	3.4	1.5	2.0	1.3	1 0 9	
Palm kernel Cake	63	24	11	7	2.8	1.1	1.3	1.3	1 2 2	
" " Meal, Extracted	67	27	11	7	3.0	1.2	1.8	1.3	1 11 8	
Soya Bean Cake (Soya Cake)	154	49	40	6	6.9	2.2	1.9	1.3	2 14 0	
" " Meal, Extracted	161	51	42	6	7.2	2.3	1.9	1.3	2 6 4	
Soya Beans	128	32	29	4	5.7	1.0	1.3	1.3	1 8 1	
Linseed	86	33	23	7	3.6	1.4	2.0	1.3	3 4 7	
Dried Yeast	122	123	45	7	7.7	5.5	1.7	1.3	2 9 3	
Locust Beans	23	11	18	1	1.0	1.3	1.8	1.0	1 0 0	
Wheat Middlings (Fine Pollards)	54	31	18	1	2.4	2.6	1.4	1.1	1 5 1	
" " Sharps (Coarse Pollards)	56	32	31	4	2.5	2.7	1.3	1.2	1 5 0	
" " Bran	54	60	33	2	2.4	2.4	1.3	1.4	1 4 4	
Oatmeal	34	54	30	2	2.1	1.9	1.3	1.3	0 18 6	
Maise Germ Meal	47	20	7	1	1.1	1.3	1.3	1.3	1 5 0	
Gluten Meal	85	15	4	2	3.8	1.7	1.7	1.1	1 5 0	
" Rico Meal	42	56	15	2	2.1	2.3	1.7	1.1	1 0 4	
Malt	38	18	11	2	1.7	1.8	1.5	1.2	0 12 11	
Malt Dst or Coombs	85	40	43	2	3.8	1.8	2.0	1.2	1 12 11	
Brewers' Grains (Wet)	19	9	1	2	0.85	1.4	1.3	1.1	0 6 3	

Weather Forecasts for Farmers.—The Meteorological Office will, as in past years, supply forecasts of weather by telegraph to persons desirous of receiving them, upon payment of a registration fee of 1s. and the cost of the telegrams, computed at 1s. per message.

The forecasts are drawn up at 10.30 a.m., 4.0 p.m., and 9.0 p.m. (summer time). Forecasts issued at the morning hour refer to the period covering the afternoon of the day of issue and the morning of the following day. Those issued in the afternoon and evening refer to the whole of the following day. All the forecasts include a Further Outlook of the probable weather beyond the 24-hour period whenever such a Further Outlook can be given.

Notifications will also be issued by telegram when conditions indicate that a spell of several days fair weather is likely, and again when the spell is about to break up. For this service a fee of 6d. is charged for each telegram despatched, in addition to the Post Office charges for telegraphy. A minimum deposit of 5s. against which the charges may be booked is required.

Applications for regular forecasts (as distinct from Spell Notifications) should specify the hour of the forecasts desired (or hours if more than one telegram daily is required). They should be sent to the Director, Meteorological Office, Air Ministry, London, W.C.2, and should be accompanied by a cheque or postal order payable to the Meteorological Committee to cover the cost of the telegrams for the period during which the forecasts are to be sent.

Further particulars and printed forms of application may be obtained from the Director of the Meteorological Office.

Applications by telegraph for single forecasts should be addressed to "Weather, London," and the reply should be prepaid.

Foot-and-Mouth Disease.—Since the issue of the *Journal* for last month was sent to press outbreaks of Foot-and-Mouth Disease have occurred in two fresh centres, namely —

At Frettenham, near Norwich, on 13th April, and

At Elmley, Isle of Sheppy, Kent, on 20th April.

The usual Order prohibiting the movement of animals over a wide area round the outbreak was, in each case, issued the same day. The action taken has so far been successful in preventing the spread of disease (except in the Frettenham case to one other set of premises in the same parish), and it has been possible to modify the restrictions on the movement of animals very considerably in both areas.

Rabies.—One fresh case of Rabies was confirmed on the 8th April, at Colchester in one of the Inner Controlled Areas, but with that exception no case of the disease has occurred in the country since 18th February last. Since the issue of last month's *Journal* the extent of the areas subject to muzzling and movement restrictions has been reduced as follows:—

North Essex and Suffolk: by the exclusion of those parts of Suffolk previously subject to the Order and a considerable reduction of the area in Essex—on 19th April.

Buckinghamshire and District: restrictions withdrawn except from the Inner Controlled Area round Wallingford and Abingdon—as from 19th April.

South Wales: restrictions removed except from the two Inner Controlled Areas round Cardiff and Bridgend by an Order dated 4th May, operating as from the 8th of this month.

SINCE the date of the list given on pp. 1038 and 1039 of the issue of this *Journal* for January last, the following leaflets have been issued in the *Permanent Series* :—

- No. 335.—*Potash Fertilisers.*
 „ 336.—*General Instructions for Cheese-making.*
 „ 337.—*Cheddar Cheese.*
 „ 338.—*Caerphilly Cheese.*
 „ 339.—*Lancashire Cheese.*
 „ 340.—*Cheshire Cheese.*
 „ 341.—*Farm Tramways.*

In addition, the information in the following Leaflets has been revised and brought up to date :—

- No. 34.—*The Woolly Aphis.*
 „ 65.—*The Small Ermine Moths.*
 „ 86.—*Brown Rot of Apples.*
 „ 105.—*Wart Disease.*
 „ 141.—*The Preparation of Honey for Market.*
 „ 148.—*Planning and Planting a Fruit Plantation.*
 „ 192.—*Farm Butter-making.*
 „ 195.—*American Gooseberry Mildew.*
 „ 215.—*Allotments : what they are and how to obtain them.*
 „ 218.—*Associations for the Creation of Small Holdings.*
 „ 242.—*Stripe Disease of Tomatoes.*
 „ 271.—*Clover Stem-rot.*
 „ 302.—*Silver Leaf in Fruit Trees.*
 „ 320.—*The Manuring of Vegetable Crops.*
 „ 322.—*Winter Pruning Bush and Half Standard Apple Trees.*
 „ 329.—*Redemption of Tithe Rentcharge and Corn Rents : The Tithe Act, 1918.*

The following *Permanent Leaflets* have been withdrawn from circulation :—

- No. 21.—*Warble Flies.*
 „ 32.—*Foul Brood or Bee Pest.*
 „ 139.—*A Mushroom Disease.*
 „ 253.—*Microsporidiosis of Bees, or Isle of Wight Bee Disease.*

Names and Routes of the Super, King's and Ministry's Premium Stallions.—The Ministry desires to give notice that the particulars of the routes of the stallions to which premiums have been awarded by the Ministry for the Service Season, 1920, together with the names and addresses of the owners of the stallions, and of the members of the Stallion Committees which have been appointed to supervise the service arrangements, will not be published in this *Journal*. Copies of a list of the names and routes of these stallions may be obtained on application to the Ministry's Offices, 4, The Sanctuary, Westminster, London, S.W. 1.

New Duties in respect of Agricultural Vehicles.—The following proposed new scale of duties in respect of road locomotives, agricultural engines and tractors was published in a statement on revenue and expenditure issued by the Treasury on 19th April. The figures are included in the Budget proposals of the Chancellor of the Exchequer for the new Financial Year.

Vehicles of the following descriptions used in course of trade, otherwise than for the conveyance of goods, and in agriculture :—

Road locomotives and agricultural engines—

Not exceeding 8 tons in weight unladen £25

Exceeding 8 tons, but not exceeding 12 tons in weight unladen £28

Exceeding 12 tons in weight unladen £30

Agricultural tractors used for haulage solely in connection with agriculture—

Exceeding 2½ tons, but not exceeding 5 tons in weight unladen £6

Exceeding 5 tons in weight unladen £10

Locomotive ploughing engines, agricultural tractors, or other agricultural engines, if not used on roads for hauling any objects other than their own necessary gear, threshing appliances, farming implements, or supplies of fuel or water 5s.

Tractors of any other description £21

National Agricultural Examination Board.—The 21st Annual Examination for the National Diploma in Agriculture (an examination conducted by a joint board of the Royal Agricultural Society of England and the Highland and Agricultural Society of Scotland) was held at the University of Leeds from 9th to 15th April. One hundred and twenty-seven candidates presented themselves on this occasion (as compared with 33 last year). Of the 127, 13 took all the subjects at one sitting, and 34 who had previously passed a portion of the examination appeared for the remaining subjects. The other 80 candidates presented themselves for a group of three or four subjects.

Of the 80 candidates who appeared for a group of three or four subjects, 35 passed, and are therefore entitled to present themselves for the remaining subjects in 1921.

ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous—

- Simpson, J. T.*—Hidden Treasure : A Tale of Modern Farming. (303 pp.) Philadelphia and London : J. B. Lippincott Company, 1919. 6s. net. [63.022.]
- Newman, L. F., and Neville, H. A. D.*—A Course of Practical Chemistry for Agricultural Students. Vol. I. (235 pp.) Cambridge : University Press, 1920. 10s. 6d. net. [54.02.]
- Gissing, F. T.*—Peat Industry Reference Book. (292 pp.) London : C. Griffin & Co., 1920. 7s. 6d. [662.6.]
- Hall, Sir A. D.*—The Soil : An Introduction to the Scientific Study of the Growth of Crops. 3rd Edition. (352 pp.) London : John Murray, 1920. 7s. 6d. net. [63.11(02).]
- New Zealand Expeditionary Force Education Department.*—Agricultural Notes. (438 pp.) London : Director of Education, N.Z.E.F., 1919. [63.931.]
- Chelmsford, East Anglian Institute of Agriculture.*—Series A. 1, Bull 25 : An Investigation of Soil Water. (7 pp.) Chelmsford, 1920. [63.112.]
- East Suffolk County Education Committee.*—Circular 121, 1919 : Report on the Results of Field Experiments carried out during the Years 1915 to 1918, inclusive. (28 pp.) Ipswich, 1919. [63.3(04).]

Field Crops—

- N. S. Wales Department of Agriculture.*—Farmers' Bull 123 : Wheat Handling and Grading in America. (17 pp.) Sydney, 1919. [63.311 ; 66.]
- Bangor, North Wales University College (Dept. of Agriculture).*—Varieties of Potatoes, 1917, 1918, 1919. (8 pp.) Bangor, n.d. [63.512(04).]
- U.S. Department of Agriculture.*—Farmers' Bull. 1095 : Beet Top Silage and other By-products of the Sugar Beet. (24 pp.) Washington, 1919. [63.3432 ; 63.604(a).]
- Wye, South Eastern Agricultural College.*—Second Report on the Trial of New Varieties of Hops, at East Malling Fruit Experiment Station, 1918. (17 pp.) Wye, 1919. [63.3451.]
- University College of North Wales, Department of Agriculture.*—Varieties of Oats. (10 pp.) Bangor, 1919. [63.314.]
- University College of North Wales, Department of Agriculture.*—The Improvement of Rough Pasture : Eradication of Bracken. (8 pp.) Bangor, 1920. [63.33-16 ; 63.259.]
- University College of North Wales, Department of Agriculture.*—Growth of Green Crops on Arable Land for Dairy Cows. (11 pp.) Bangor, 1920. [63.33(04).]
- Lancaster County Council, Education Committee.*—Farmers' Bull 32 :—Report on Field Trials with Varieties of Potatoes. (9 pp.) Preston, 1920. [63.512(04).]
- Lancaster County Council, Education Committee.*—Farmers' Bull. 33 :—Report on Field Trials with Varieties of Mangels. (12 pp.) Preston, 1919. [63.332.]
- Lancaster County Council Education Committee.*—Farmers' Bull. 34 :—Report on Field Trials with Varieties of Swedes. (12 pp.) Preston, 1920. [63.332.]

Horticulture—

- Moore, W. G., and Smith, A.*—Romance of the "Wonder Plot." (84 pp.) London : Romance Publishing Company, 1920. 2s. 6d. net. [63.5(06).]

Plant Diseases—

- Sarsfield, J.*—Insect Pests and How to Beat Them, including Notes on Plant Diseases, Soils, and Manures. (202 pp.) London : C. Arthur Pearson, 1919. 3s. 6d. net. [63.27(02).]
- Sutton, M. H. F.*—The Future of the Potato Crop, with Special Reference to Wart Disease, and Immune Varieties. (21 pp.) [Jour. of Farmers' Club, February, 1920, 6d.] [63.24.]
- Hiley, W. E.*—The Fungal Diseases of the Common Larch. (204 pp.) Oxford : Clarendon Press, 1919. 12s. 6d. [63.24-49.]

Live Stock—

- Shanahan, E. W.*—Animal Food-Stuffs: Their Production and Consumption, with a Special Reference to the British Empire. (331 pp.) London: Geo. Routledge and Sons, 1920. 10s. 6d. net. [63.6:31; 31(42)].
- Pearse, A. W.*—The World's Meat Future. 2nd edition. (335 pp.) London: Constable & Co., 1920. 21s. net. [63.6:31; 664.8.]

Dairying and Food, General—

- Publow, Chas. A.*—Fancy Cheese in America: From the Milk of Cows, Sheep, and Goats. (96 pp.) Chicago: American Sheep Breeder Company, 1910. [63.73(02).]

Veterinary Science

- M'Fadyean, Sir J.*—Tuberculous Mastitis in the Cow: Its Pathogenesis, and Morbid Anatomy and Histology. (54 pp.) [Reprinted from the Journal of Comparative Pathology and Therapeutics, Vol. xxx., 1917.] [619.2; 614.5.]

Birds, Poultry and Bees—

- North of Scotland College of Agriculture.*—Bull. 25:—Some Hints for Prospective Bee-keepers. (8 pp.) Aberdeen: Milne & Hutchinson, 1920. [63.81(04).]
- Paynter, F. G.*—The Development of the Poultry Industry and Small Holder Movement. (23 pp.) Hounslow: The Author, 1920. [63.651(04).]

Forestry—

- Engler, A.*—Untersuchungen über den Einfluss des Waldes auf den Stand der Gewässer. [Mitteilungen der Schweizerischen Zentralanstalt für das forstliche Versuchswesen. Band xii. (626 pp.) Zurich: Beer & Cie, 1919. [63.49-14.]]
- Grieve, Mrs. M.*—Economic Trees and their By-Products. (70 pp.) Chalfont St. Peter, Bucks.. The Whins Medicinal Herb. School, n.d. 1s. 6d. net. [58.16; 63.49-197.]
- Kew, Royal Botanic Gardens.*—Official Guide to the Museums of Economic Botany. No. 4, British Forestry. (143 pp.) London: Royal Botanic Gardens, 1919. 2s. net. [579, 63.49(064).]

Engineering—

- Malcolmson, V. A.*—Rural Housing and Public Utility Societies. (8 pp.) London: John Murray, 1920. 6d. net. [69(04).]

Econom:

- Rew, Sir R. H.*—Food Supplies in Peace and War. (183 pp.) London: Longmans Green, 1920. 6s. 6d. net. [63(08); 31(42).]
- Jackson, T. C.*—The Agricultural Holdings Acts, 1908-1914, together with a Manual on Tenant-Right Valuation. [4th Ed.] (300 pp.) London: Sweet & Maxwell, 1920. [347(a).]
- National Farmers' Union.*—What the N.F.U. is Doing for the Farmer. A Brief Record of the Work of some of the Committees at Headquarters during the year 1919-20. (47 pp.) London: National Farmers' Union, 1920. [63(06).]

THE JOURNAL OF THE MINISTRY OF AGRICULTURE

Vol. XXVII. No. 3.

JUNE, 1920.

NOTES FOR THE MONTH.

THE Agriculture Bill was presented to the House of Commons just before the Whitsuntide recess, and it is understood that every effort will be made to secure its passage through both Houses before the present Session ends. The Bill is divided into two parts, the first being, in effect, an amendment of the Corn Production Act of 1917, and the second an amendment of the Agricultural Holdings Acts, 1908 to 1916. The principle of guaranteed minimum prices for wheat and oats is continued, the standard adopted being the one suggested by the Majority Report of the Royal Commission of Agriculture. The prices are to be based upon the following prices for the standard year (1919), namely, 68s. for 504 lb. of wheat, and 46s. for 336 lb. of oats. Three Commissioners are to be appointed, one by the three Agricultural Departments, another by the Treasury, and the third by the Board of Trade, to consider to what extent the cost of production in any given year has varied from the cost in the standard year, and the guaranteed minimum prices for each year will be fixed accordingly. Any payment due will be made after the end of the March following, as under the Corn Production Act. The Corn Production Act is made permanent, except that the guaranteed prices may be terminated by an Order in Council made on an Address presented by both Houses of Parliament,

but only at the expiration of four years from the date of the Order. This period will be sufficient to enable farmers to re-arrange their crop rotation.

Orders for a change in cultivation can be made only where this is not calculated to injure the persons interested, and they can appeal against an Order to an Arbitrator. Landlords can be required to execute such landlord's repairs as are required to secure proper cultivation, and in case of failure to comply the Minister of Agriculture can authorise the tenant to execute the repairs and recover the cost from the landlord. The latter has a right of appeal against the Order.

From the second part of the Bill the farmer derives additional security against loss by eviction. Any tenant forced by his landlord to leave though not in default, will receive full compensation for all direct loss, together with a sum equal to one year's rent. If notice to quit is given capriciously, or for reasons inconsistent with good estate management, additional compensation up to four years' rent may be given by the Arbitrator. To enable rents to be adjusted without notice to quit, it is provided that if a tenant refuses to arbitrate as to any increase of rent, and the landlord determines the tenancy, the tenant cannot claim for disturbance. If, on the other hand, the tenant asks for a reduction in rent, and in consequence of the landlord's refusing arbitration on the point the tenant gives notice, the tenant may recover compensation for disturbance. Compensation for permanent improvements may be obtained by the tenant, provided that the Agricultural Committee has sanctioned the improvements. In such a case the landlord may elect to make the improvement and charge an additional rent for so doing. The Bill also provides for the application by the Agricultural Committee to a farm, or part of a farm, of the general principles of the Evesham custom for fruit land and market gardens. This custom is for the outgoing tenant to find another tenant to take his place and undertake the liability for compensation, the landlord having to pay the compensation for market garden improvements only if he refuses his outgoing tenant's nominee or gives his tenant notice to quit. Additional compensation is given to a tenant who can prove that he has continuously adopted a specially high standard of farming in excess of that required by his contract of tenancy or by custom. The Bill, with certain modifications, applies to Scotland and Ireland as well as to England and Wales, and it is proposed that it shall come into force on the 1st September next.

Now that the Agricultural Shows have fully resumed their work after the long interruption of war, there is abundant

The Advantages of Agricultural Shows. evidence that the organisers of these exhibitions are more than ever alive to the importance of educational exhibits.

They realise that it is not sufficient merely to display a good machine or a good article of produce, but that its virtues must be made widely known by attractive demonstrations.

At a number of this year's shows there will be an exhibit illustrating the many-sided work carried on by the Ministry for the improvement of crops and stock, the prevention of disease, the betterment of housing and land drainage, and the general promotion of rural welfare. The Ministry's Exhibit includes specimens of seeds and the methods of seed testing, models of the cottages now being erected on County Council holdings, photographs of plant and animal diseases and land drainage operations, and examples of rural industries, such as basket work and other home handicrafts. At the Ministry's Exhibit visitors may obtain, free of charge, a supply of informative literature, and authoritative leaflets and pamphlets, giving most useful instruction in every branch of agricultural science. Far too few people interested in the land realise the existence of this literature. None should miss the opportunity of visiting the Ministry's Exhibit.

In an increasing measure, Agricultural Shows are disseminating the latest scientific knowledge of agricultural matters. The greatest effort in this direction will be made at the Royal Show, to be held from 29th June to 3rd July at Darlington. The Ministry's Exhibit will be housed in a special pavilion. Other important forthcoming events are the Lincolnshire Show at Grimsby, on 14th, 15th and 16th July; the Royal Lancashire Show at Bolton, from 29th July to 2nd August; and the United Counties at Carnarthen, on 12th August. Later autumn shows will be announced in due course. At all of these the Ministry will be represented.

* * * * *

AN ounce of practice, the proverb says, is worth a pound of theory, and, following this old maxim, the Ministry

**Improvement of
Grass Land: Local
Demonstrations.**

has sought to arrange for farmers to carry out on their own fields experiments in the improvement of grass land. The object of these local demonstrations is that farmers and their neighbours, as they go about their

daily work, may see for themselves what beneficial results arise from the application of the latest scientific methods. The work of providing for these demonstrations was entrusted to the Local Agricultural Education Authorities throughout the country, and although the scheme was initiated only in the middle of January, by the middle of May some 180 demonstrations were actually in progress in 26 out of the 46 counties of England, while arrangements were being made for similar experiments in a further 9 counties. The remaining 11 counties will, it is hoped, shortly take similar action. The scheme is also being carried out in Wales, and, of course, most of the Agricultural Colleges are conducting experiments on grass land. The fields where the experiments are carried out lie in prominent positions, and by next autumn it is hoped that the gains resulting from the treatment of the grass will be able to be judged by local farmers and passers-by who can look upon the fields with an intelligent eye. These practical object lessons are reinforced by a series of lectures delivered by the most eminent authorities on grass-land problems in the country.

THE Acreage and Live Stock Returns for 1919, just issued by the Ministry, review the general position in recent years, and

**Acreage and Live
Stock Returns.**

special reference is made to the recovery in the arable area resulting from the Government policy of breaking up grass land for food production. For the 40 years previous to 1915, a regular feature of the Returns had been, with few exceptions, a decline in the arable area, but between 1915 and 1918 no less than 1,400,000 additional acres were put under the plough; that is to say, in the short period of three years, the entire loss recorded in the 20 preceding years was recovered. In 1918, the actual proportion of land under the plough was slightly larger than it was in 1898, being 46 per cent. of the total area under crops and grass, as compared with 45 per cent. 20 years earlier. In the same period, the total area under crops and grass decreased to 600,000 acres, owing chiefly to the absorption of land for residential and industrial purposes. This fact renders more striking the large increase of arable, as it was only accomplished by breaking up permanent grass to an extent that reduced the area to less than it had been at any time in the preceding 30 years. During this period, however, an additional area of mountain

and heath land, amounting to 550,000 acres, appears to have been brought into use for rough grazing. This practically counter-balanced the decrease in permanent pasture.

It has been sometimes doubted whether the crops from newly-broken land fully justified conversion of permanent grass into arable. Fortunately, it can be shown that although the yields of all the corn crops on the new arable were less on the general average yield of corn crops in England and Wales, they were not appreciably less, except perhaps in the case of barley. As a whole, they compared very favourably with the 10-year average. Potatoes were quite favourable, but this crop was not largely grown on the newly-broken land. When due allowance is made for the unfavourable harvest conditions in September, 1918, the Returns appear fully to justify the plough policy as a means of increasing the Nation's food supply. It is beyond question that the total amount of food obtained from the new arable land saved the importation of several hundred thousand tons of equivalents, and thus set free a corresponding amount of shipping for war service.

As regards the question of Small Holdings, the Returns show the following fluctuations. In 1903, the total number of holdings was 433,000; in 1908 it had fallen to 430,000. In that year, with the passing of the Small Holdings Act, the movement gained ground, and by 1912 the number of holdings had risen to 435,900. At this point development ceased and, remaining almost stationary for 2 years, thereafter declined rapidly, so that between 1913 and 1919 the loss was no less than 19,000. The reasons for this remarkable decline will be found partly in the absorption of small holdings near towns for industrial purposes, but mainly, perhaps, in the conversion into allotments of fields previously returned separately. If the latter explanation of the decline in the number of holdings below 20 acres be correct it means that while the number above one acre in extent has diminished, the total area under cultivation has not in all probability decreased. An apparently alarming feature may therefore, on stricter examination, be viewed with equanimity.

The position regarding livestock in 1919 was fairly favourable for horses. Cows and other cattle were distinctly above pre-war level. Sheep and pigs were both abnormally low. This decline is mainly attributable to the measures which had to be taken to the control and ration the meat supplies.

As a result of a Conference held in Chicago on 6th and 7th October last, a Report was submitted to the Secretary of Agriculture, recommending that Congress be asked to provide funds for carrying out trials in farm power problems, to be undertaken by the United States Department of Agriculture in co-operation with the State Colleges.

Farm Power Problems.

At the Conference the various interests concerned—farmers and horse breeders ; tractor and implement makers ; saddlery and feed-producer representatives ; workers from farm management, animal husbandry and agricultural engineering departments of the agricultural colleges ; and representatives of interested bureaus of the United States Department of Agriculture—were given the opportunity of presenting their views.

It was agreed that the most urgent problem before the American public to-day is how to lower the high cost of living, and that the key to this, in American agriculture, is to be found in increased and more economic production, which would come chiefly through a more efficient utilisation of farm power. The Conference realised that the power problems needing immediate attention were many and complex, and the various interests represented pledged their active co-operation in carrying out the necessary investigations and demonstrations.

A programme of work was drawn up. This included studies of the economic factors, such as farm power requirements for field operations, hauling and other work ; animal power ; mechanical power ; relation of forms of farm power to man labour ; and the influence on the farm organisation and operation of the size of the farm, the character of the soil, the intensity of culture, etc.

The Committee appointed by the Department of Agriculture drew up a scheme of investigation under seven heads :—

1. Testing and rating of farm tractors ;
2. Determination of the working rating of horses ;
3. Measurement of power requirements of machines and implements ;
4. Development of practical methods of expanding the power of farm horses ;
5. Determination by field studies of the mechanical efficiency of horses as power units ;
6. Increasing the economic efficiency of horse and tractor power by the re-adjustment of the size of the farm and the combination of enterprises ;
7. Compiling accurate data concerning farm power demands and the relative cost of meeting these demands by the various kinds of power on farms.

1. *Testing and Rating of Farm Tractors.*—This head will cover field and laboratory tests for the purpose of determining the belt or brake horse power and the drawbar horse power, as well as the fuel consumption of the tractor. Tests will be made under varying load conditions, probably at half and full load as rated by the manufacturer and also at the maximum load that can be developed. The tractors will be operated at the speeds recommended by the manufacturer. There will be an endurance test for the purpose of showing any defects that may exist, and also for determining whether the rated load can be secured under conditions of continuous operation. It is proposed to issue a card showing the rating of tractors.

2. *Determining the Working Rating of Horses.*—Under this head it is proposed to make controlled tests to determine the possibilities and limiting factors in relation to the generation of power by horses of different types. When such preliminary work has been so far carried out as to indicate what type of horse is most efficient as a power unit, teams of such types should be studied in adequate numbers at different points to determine the extent to which age, weight, temperament, sex, condition, soundness, climate, topography, overload, speed, and feed affect the efficiency of horses as power units.

3. *Measurement of Power Requirements of Machines and Implements.*—Studies will be carried on to determine the power required to operate the principal types of field and stationary machinery under the varying conditions arising in farming practice. Ploughs and other tillage implements will be operated in connection with a dynamometer, and the power required to pull the given sizes in various kinds of soil and at different depths of tillage will be determined. Stationary machines, such as ensilage cutters, feed grinders, grain separators, etc., will be tested to determine the power that must be delivered to the belt wheel of the machine and the most effective speed of operation.

4. *Development of Practical Methods of expanding the Power of Farm Horses.*—These investigations should have reference to the economy, efficiency, and more complete utilisation of the horse power existing on the farm, including the use of 4-, 6-, and 8-horse teams; to the use of horses in every possible way as auxiliary power units, including the use of hitches; and to the utilisation of large machinery, such as 2- and 3-bottom gang ploughs, double-disk harrows, culti-packers, 2-row cultivators, large mowers, rakes, binders, and hay loaders.

5. *Determination by Field Studies of the Mechanical Efficiency of Horses as Power Units.*—This can be best determined by the application under field conditions of the principles worked out under heads 2 and 4.

6. *Increasing the Economic Efficiency of Horse and Tractor Power by the Re-adjustment of the Size of the Farm and the Combination of Enterprises.*—This head covers the use of the farm data gathered by survey and cost-accounting methods to show the relation of the various forms of farm power to*:

- (a) Total farm profits ;
- (b) Utilisation and distribution of man labour ;
- (c) Peak-load and slack labour demand periods on the farm ;
- (d) Utilisation of the farm area by various combinations of crops ;
- (e) The increase and decrease of the total farm area due to the use of farm power ;
- (f) The establishment and maintenance of live-stock enterprises on the farm.

7. *The Compilation of Accurate Data concerning Farm Power Demands, and the relative Cost of Meeting these by the various Kinds of Power.*—This work will be concerned with power requirements at various seasons for different types of farming. The data collected will show the amount and kind of power used throughout the year, and the cost of performing specific operations by the different forms of power. The cost has a direct influence on the total farm profits, which is the economic basis for the choice of power.

* * * * *

THE importance of standardisation in agricultural machinery and implements was urged by a number of witnesses who gave evidence before the Departmental Committee on Agricultural Machinery. It was agreed that a reduction in the diversity of parts and their interchangeability between implements of the same type are much to be desired. The present bewildering variety of ploughs, for example, produced by individual makers, all in turn differing from those of other manufacturers, and with relatively few fittings common to any of them, increases the difficulties of the users and must necessarily add to the cost of production. Progress in the adoption of standardised methods has been made in America, and tractor manufacturers in this country are also devoting attention to the question.

**Standardisation of
Agricultural
Machinery.**

Standardisation is likely to be greatly assisted by the progress of research, but good will on the part of the various manufacturing interests concerned should accomplish a great deal in the immediate future. Each section of the industry would clearly require to be considered separately, and the prospects of effective work would be found more favourable in some cases than in others. Ploughs and other implements of cultivation appear to afford considerable possibilities of standardisation. The question is one which could no doubt suitably be considered by a Research Association either of the whole trade or any of its sections. The active assistance of the British Engineering Standards Association is assured in advance.

* * * * *

THE Eastern Counties are fortunate in having agricultural demonstrations brought, as it were, to their very door, by the energy and enterprise of the Great Eastern Railway. This Company has now inaugurated its Demonstration Train, which is, in effect, a mobile exhibition

**The Great Eastern
Railway Demonstration
Train.**

of the most approved methods of poultry rearing, rabbit breeding for fur, beekeeping and general horticulture, applicable to small holders and fruit growers. The train, it is interesting to know, was originally used in the War Hospital Service. In the horticultural coach is an exhibit representing fruit and allotment culture, plant diseases, and fruit and vegetable preservation. Methods of grafting and pruning, photographs of fruit trees, of model allotments, specimens of implements, and the apparatus of bee-culture, are included in the exhibition. Fruit growers, who know only too well how seriously apple-scab, mildew and similar diseases have affected prices of home-grown produce, can here study the various sprays and spraying machines which are so great an aid to the production of clean fruit. Bee-keepers and prospective bee-keepers will be able to handle and examine the latest forms of apparatus, and those specially interested in potatoes can study means of preventing disease. Onion growers will have an opportunity of becoming acquainted with the symptoms of onion-smut, which has lately obtained admittance into England by means of foreign seed. A special exhibit has been arranged to enable cultivators to recognise and cope with this trouble. There is also a display of bottled fruits and vegetables, together with the various types of bottles, cans, ovens and sterilisers. Practical demonstrations of methods and processes will be given from time to time by expert lecturers. Three officers of the Ministry accompany the train.

• • • • •

CANADA is the birthplace of Women's Institutes. Twenty-two years ago, a little group of countrywomen in Ontario met to discuss the question of lightening the

The Progress of loneliness of their lot on the remote
Women's Institutes. farmsteads. They thought that something could be done to make life better and brighter both for themselves and their children. They met at each other's houses at fixed intervals, not only for social entertainment but also for devising means to secure the various improvements their homes and the district required. Thus the Women's Institute came into being.

Very soon the homes and the farms showed what changes could be accomplished through the efforts of an organised band of intelligent women. This example inspired other women, and before long the institute movement had spread through Canada, and thence into the United States. In 1915, it reached Great Britain, by way of Wales, where, in September of that year, at Llanfairpwll, Mrs. Watt, a British Columbian, started the first Women's Institute in Great Britain. Two months later, the first English Institute was formed by Mrs. Watt at Wallisdown, East Dorset. The number of Institutes thereafter rose rapidly, and by April, 1919, there were 885 Women's Institutes in England and Wales. The number has now risen to over 1,600, and will certainly increase, for these centres of industry and recreation are imparting to village life much of the stimulus needed. Towards the close of 1917, the Ministry undertook the propaganda of the movement, and placed the organisation under the control of the Women's Branch of the Food Production Department. In October last, however, the Ministry relinquished control of the movement, and the whole propaganda and Headquarters work of the Institutes is now conducted by the National Federation of Women's Institutes through an Executive Committee selected by the Institutes themselves.

A Women's Institute is a democratic body. The Committee, elected by the members, is representative of all the women in the village who join the Institute. Through the Institute, women in rural districts can demonstrate that life in a village can be at least as attractive and interesting as life in a busy town or city. Local Authorities have more than once recognised the important part performed by Institutes in rural development by consulting them as to the type of house best suited to the district.

During the War, Women's Institutes mainly concerned themselves with the production, preservation and economy

of food. These important activities are being continued, but work is steadily extending in other directions in order to meet local requirements. An Institute helps each woman to realise her individual duty to the community, and encourages every member to give of her best. Thus, the successful jam-maker discloses her secret recipe; the best bread-maker demonstrates the reason for the lightness of her loaves; the expert bee-keeper gives a practical talk on the wonders of the hive; and the student reveals the treasures of local history. It is, indeed, difficult to exhaust the list of all the Institute's activities. It promotes a higher cultivation of field and garden; it encourages pig and goat keeping, cheese making, fruit bottling, toy, hat and basket making, chair caning and co-operative marketing; it organises egg-collecting and communal kitchens. Institute members have also achieved excellent results in fur craft. Several Institutes have cross-bred their own rabbits to obtain skins of the desired colour. The workers cure the skins, from which they manufacture fur gloves and fur-lined slippers of high-grade quality. Weaving, spinning, knitting and needlecraft are also practised. These are only a few of the efforts engaging attention. Home handicraft, which was taken up spontaneously, has become such an important part of the Institute's activities that it now calls for some measure of control in order to achieve the best results. For this reason, an Industries Sub-Committee has been established at Headquarters to promote and co-ordinate this side of the Federation's work. Various considerations prove the necessity of such supervision. Institute workers, in their eagerness to produce, have not invariably taken pains to secure excellence. This defect was accentuated by the abnormal conditions of the war market, which readily absorbed all goods, including those that were not of the best quality. It is now realised, however, that a high standard of workmanship is required. The task facing the National Federation of Women's Institutes is to secure an adequate supply of teachers. The plan adopted is by means of Guilds of Learners in Handicraft. Guild Schools will be established for training teachers in various branches of home industries, and the provision of qualified instructors will be the first step towards raising the standard of work.

In order that each Institute might be fully acquainted with the progress of the movement and with the activities of every other Institute, the Federation Headquarters publishes a monthly magazine, "Home and Country," and in this way

the centres are kept in touch with each other and the movement is popularised. County conferences and exhibitions are also held periodically, while the Third Annual Exhibition held in London last month attracted widespread interest.

Women's Institutes are taking their share in the life of the country. They aim at improving the conditions of rural life by stimulating interest in the agricultural industry, developing co-operative enterprise, encouraging home and local industries, studying home economics, and providing centres for educational and social intercourse as well as for all local activities.

(Notes on Women's Institutes appeared in this *Journal* in January, 1917, p. 966, October, 1918, p. 827, and December, 1919, p. 939.)

* * * * *

THE Ministry has had under consideration the advisability of increasing the grants payable to bull, boar, and milk-recording societies. Having satisfied itself that the

**Increase in the
Value of the Grants
payable to Societies
under the Live Stock
Scheme.**

amount of present grants is not adequate to secure the provision of good pedigree sires and to encourage the keeping of milk records, it has increased, as from the 1st April, the grant for bulls from £15 to a maximum of £20, the grant for boars from £3 to a maximum of £5, and the milk-recording grant from £2 10s. a herd to £3, except to Societies for their first and second year of operations, when the grant will be £3 10s. a herd.

When the scheme was brought into operation in 1914, the amount of the grant payable to a bull society was fixed at £15, of which £12 was to be paid to the farmer who provided the bull, and the remaining £3 was utilised for defraying the expenses of the society. The subsidy for a boar was £3. In 1914 the average price of the bulls provided was £36 and of boars £7, and a subsidy of £12 and £3, respectively, was, therefore, sufficient. At the present time, however, the average price of bulls provided under the scheme is approximately £62 and that of boars £14, and as pedigree stock, feeding stuffs and labour have increased in price very considerably since 1914, there are good grounds for increasing the grants. As from the 1st April, the amount of the grant to societies will, therefore, be one-third of the value of the bull, until the society has been in operation for five years. Thereafter the rate will be one-quarter the value of the bull, subject to a maximum grant in both cases of £20. The full amount of the grant is to be paid

to the bull owner, and any administrative expenses incurred by the society are to be defrayed by subscriptions or levies from the members.

The grant for boars will be at the rate of one-third of the value of the boar, subject to a maximum grant of £5.

The grants made to milk-recording societies are also increased in order to encourage the formation of new societies and to secure the provision of reliable and qualified recorders.

The amount of grant that has been paid in the past has been at the rate of £2 10s. per herd per year, subject to a limit of one-half the expenses of a society, but it is recognised that until farmers have proved the commercial value of keeping milk records they are disinclined to pay a levy of 3s. to 5s. per cow, which is the approximate charge made to members of milk-recording societies. It has, therefore, been decided to increase the grant to a milk-recording society for the first and second year of its operations from £2 10s. to £3 10s. a herd, and subsequently the maximum grant will be a maximum of £3 a herd.

It is hoped that the increase in the grants will remove some of the difficulties that have been experienced in forming new societies, and will lead to a more rapid extension of the Live Stock Scheme during the current year.

* * * * *

In the investigation of possible control measures for certain seed-borne diseases of cereals that do not yield to the ordinary chemical and hot water seed treatments, dry heat has been found particularly adaptable.

**Seed-borne Diseases
of Cereals: Possible
Control by Dry
Heat.**

Experiments carried out by Mr. D. Atanasoff and Mr. A. G. Johnson, of the University of Wisconsin, are described in the *Journal of Agricultural Research* (Vol. viii., 2nd January, 1920, p. 379). It was first attempted to duplicate Naumov's treatment of 1916, in which cereals were subjected to 60° C. for periods ranging from 24 hours to 3 days. This, it was thought, would also kill, or at least greatly weaken, the fungus mycelium present in the interior of the kernels. It was found difficult to verify his results. Wheat and barley thus treated retained their viability, but so did various fungi that infected the kernels. Following this, higher temperature and longer exposures were tested with rather surprising results. Wheat and barley kernels remained viable even after an exposure to heat ranging from 100° to 110° C. for as long as 45 hours. It was soon found possible by reducing this time to lessen the injury to the seed and yet kill the most persistent parasites.

With the exception of one series, all the experiments were made in a gas-heated sterilising oven, ventilated and kept at a constant temperature. In the first experiment, small lots of infected kernels of Kubanka durum wheat and Chevalier barley were exposed to 100° or 110° C. in the gas oven for 15-hour and 30-hour periods. A series of culture experiments were made on the treated seeds to compare them with the untreated. In most cases, *Gibberella*, *Fusarium*, *Helminthosporium* and *Alternaria* developed from the unheated kernels of wheat and barley, as well as from kernels that were heated for 15 hours. From the kernels heated for 30 hours, however, only two yielded fungus growth.

For the second experiment, various grains were treated in a large electrically-heated drying oven at a temperature of about 100° C. in order to test the effect of 15-hour and 30-hour exposures on germinability. Samples of treated and untreated kernels were then sown in sand in the greenhouse. The results showed that good dry seed of barley, wheat, oats and rye was able to withstand this high temperature up to 30 hours. Previous tests had shown this time and temperature to be fatal even to the persistent parasites.

In the third experiment, only seeds known to be infected with various diseases were used. The temperature averaged 100° C. for 30 hours. Samples of the treated and untreated seeds were sown. The result showed that the barley was not killed and that there was perfect control of the diseases, while the untreated seed was heavily infected.

In a fourth test, wheat, oats and rye were submitted to a temperature of about 100° C., and were found capable of withstanding this severe drying process, though with certain samples the germination was seriously reduced.

Field sowings of all the seed lots of the barley, wheat, rye and oats treated in experiments 3 and 4 were made on an isolated place on the University farm. Care was taken to avoid contamination of seed from any source. The results were, on the whole, satisfactory. Not only could the bacterial blight of barley and oats be controlled by the dry-heat treatment, but there was also a likelihood that it would prove efficient in controlling the "blackchaff" of wheat. Applied to wheat infected with "scab," the treatment also pointed to the possibility of eliminating seed infection. Further, "spot blotch" and "netblotch" in barley were partially eliminated by the treatment, which also diminished the percentage of loose smut infection in both barley and oats.

The experiments, which are being continued, suggest promising possibilities. The data at hand indicate that well-dried barley, wheat, rye and oats of good quality are able to withstand protracted exposures to dry heat at comparatively high temperatures. They also show that seed infections from bacterial blight of barley and oats may both be eliminated by exposing the infected seed to dry heat at temperatures that leave the seed still viable. Finally, it is demonstrated that stripe disease of barley, and *Helminthosporium* blotch of oats, as well as loose smut of barley and smut of oats, are markedly reduced without materially injuring the germination of the seed.

* * * * *

A REPORT of the potato trials carried out last year by the East Sussex County Council has recently been received by the Ministry. Experiments were made both with regard to the cropping and the cooking qualities of certain well-known varieties of potatoes, and some interesting results were obtained.

**1919 Potato Trials
in East Sussex.**

Cropping tests were carried out at five centres, with the results given below.

At *Hellingly*.—The land was not ideal potato land, but was liberally manured and good crops were obtained.

Variety.	Class of Seed planted.			Crop per Acre. Tons c. qr.		
King George ..	Scotch	.	.	16	3	0
Pioneer ..	—			—		
Lochar ..	..	..	..	15	14	0
Arran Chief ..	..	..	..	13	15	0
Great Scot ..	..	..	..	13	14	0
Arran Chief ..	Local, once grown from Scotland.			8	12	0
Templar ..	.. Scotch	..	..	8	8	0

It will be noted that King George yielded 7 tons 15 cwt. per acre more than did Templar, and that Arran Chief (Scotch seed) gave a yield of 5 tons 3 cwt. per acre more than the locally-grown seed of the same variety.

At *Albourne*.—Similar results were obtained, except that Great Scot gave a slightly better return than Lochar.

At *Pett*.—The plots here were about one-tenth of an acre in area. A subsidiary test was made as to the value of spraying, but owing to the abnormally dry season the advantage obtained

was negligible. When the crops at this centre were weighed, ware, seed and chats were calculated separately, as shown in the table below :—

—	Lochar.	King George	Arran Chief (Sprayed).	Arran Chief (Unsprayed)	Templar.
	Cwt qr lb	Cwt qr lb	Cwt. qr lb.	Cwt. qr. lb.	Cwt. qr lb
Ware ..	13 1 18	13 0 20	11 1 15	11 1 0	5 3 26
Seed ..	2 1 0	1 3 8	3 0 24	3 0 20	2 2 10
Chats .	0 3 18	0 2 25	0 3 25	0 3 24	1 3 3
Total for Plots	16 2 8	15 2 25	15 2 8	15 1 16	10 1 11
Total cal- culated per acre	1. c qr 13 15 0	T c qr 13 1 0	1 c qr 12 18 2	T c. qr. 12 15 2	1. c. q1 8 11 3

The large proportion of small tubers in the Templar variety is worthy of note.

At *Northiam*.—The agricultural organiser reports that the land at this centre was not nearly so uniform throughout as at the other centres. The results were again very similar to those obtained at *Hellingly* (above), but the highest yield was from Arran Chief (13 tons 10 cwt.), followed by Lochar (12 tons), King George (10 tons 5 cwt.) and Great Scot (10 tons).

At *Pevensey*.—The land at this centre was very poor. Three kinds of Arran Chief seed were included in the test, and as the yields varied from only 5 tons 2 cwt. for Lochar to, $\frac{1}{2}$ ton 14 cwt. for Arran Chief (local seed, once grown from Scotland) they are not worth full record here.

The results demonstrate that, of the varieties tested, Lochar is the one giving the best yields in East Sussex. The order of merit is (1) Lochar, (2) King George, (3) Arran Chief, (4) Great Scot, (5) Templar, the last named being apparently quite unsuited to the soil throughout the county.

The trials also indicate that in good soil, approximately an extra $4\frac{1}{2}$ tons per acre may be obtained by planting Scotch seed in lieu of that grown locally.

In addition to these cropping tests, the East Sussex County Council arranged for a test of the cooking quality of the above-mentioned varieties, and also of one or two other varieties grown in the county. The test was carried out by the East Sussex School of Domestic Economy at Lewes. The results

are tabulated below, the total marks showing the order in which the varieties were placed in regard to cooking quality. :—

Maximum Marks—5.	Ally.	Arran Chief (Scotch).	King Edward.	King George.	Majestic.	Arran Chief (Local)	Lochar.	Templar.
Boiling	5	5	5	3	5	3	3	3
Steaming	5	5	4	4	4	4	3	3
Baking	4	4	3	5	3	5	5	3
Total	14	14	12	12	12	12	11	9

DURING the last year the Ministry arranged for propaganda work to be carried out by one of their inspectors amongst farmers and potato merchants in Lincolnshire, with a view to making clear their responsibility in relation to the introduction of disease when buying seed potatoes. The main object of the work, which was carried out with the co-operation of the branches of the National Farmers' Union, was to secure that only those potatoes grown in districts free from wart disease should be introduced into Lincolnshire for planting from outside districts.

The work fell into two parts. The first was interviewing merchants, growers and farmers in the county, who were this season obtaining seed potatoes from Scotland. The chief object of these interviews was to ascertain if the growers and dealers had complied with the Wart Disease of Potatoes (Scottish Seed Potatoes) Order, 1919.* In the event of their not having done so, they were asked to communicate immediately with the Scottish merchant from whom they were obtaining their "seed," and request either to be furnished with the necessary certificate and declaration, or, failing that, with a definite statement in writing from the merchant that he held these documents.

In all cases where the Order had not been complied with, farmers, growers and merchants were asked to communicate the result of their inquiries to a central authority.

Information was also collected as to the usual channels from which Scotch "seed" was obtained, and lists of merchants dealing in Scotch "seed" were procured. A list of the names of Scotch dealers with whom Lincolnshire growers generally

* See this *Journal*, January, 1920, p. 1023.

deal was compiled, and information was also obtained as to the varieties of potatoes chiefly grown in the county. This information, no doubt, will prove of great assistance in future seasons.

As a result of these inquiries, it was ascertained that in very few cases did farmers deal directly with Scotland. Most frequently they obtained the "seed" through a local merchant. It was shown that most of the merchants interviewed had not complied with the Order, nor had the Scotch merchant, except in a few instances, voluntarily offered to supply the certificate and declaration, and in all cases the excuse offered by English merchants was total ignorance of the Order. The Ministry's representative pointed out that the variety "Arran Chief" was, more than any other, susceptible to wart disease, and that extra care should be exercised in obtaining this variety from Scotland. Many interesting particulars were also obtained as to the relative popularity of varieties. For First Earlies, "Eclipse" is by far the most popular. Among the Second, "British Queen" takes first place, and among Main Crops, "King Edward" leads easily. "King Edward" and "Evergood" comprise at least 50 per cent. of the Main Crops grown in the county. Among immune varieties "Majestic" appears to be popular among the growers. "Great Scot" holds the next place, while "Dargill Early" and "Arran Comrade" have been taken up by a considerable number of farmers in the Holland District of Lincolnshire.

The second division of the work consisted in addressing meetings of farmers in different parts of the county. At these meetings, the Ministry's inspector described the disease and pointed out the great danger of infection from "seed" obtained from infected areas and the consequences that would follow an outbreak of wart disease. The lecturer also explained the Wart Disease of Potatoes (Scottish Seed Potatoes) Order, 1919, and all other regulations bearing upon the disease. He described the chief immune varieties of potatoes, and mentioned to seed growers the advantages to be derived from the Ministry's free inspection of their growing crops. At the conclusion of several of the meetings resolutions were passed urging the Ministry of Agriculture to bring in any further regulations it considered necessary in order to safeguard the county against risk of infection from seed potatoes obtained from Scotland.

It has been brought to the notice of the Ministry that there are being put upon the market certain proprietary dressings for seed potatoes which are stated to be effective in preventing the development of "Potato Blight."

**Potato Blight:
Uselessness of Seed
Dressings.**

As this disease is reproduced each season from the mycelium or vegetive threads of the fungus actually within the tissues of the tuber, it is useless to expect any external dressing to kill this mycelium without also injuring the tuber. Moreover, the subsequent epidemic character of the disease is due to the development of spores on the foliage of affected plants. These spores are carried from plant to plant and from field to field. The Ministry, therefore, advises growers to exercise caution.

The only really effective preventive of blight is spraying at the proper season, *i.e.*, in late June or early July, with a good fungicide such as Bordeaux mixture (copper sulphate combined with lime) or Burgundy mixture (copper sulphate combined with washing soda), applications used for many years in the vineyards of the Continent. By the timely use of these dressings the spores of the fungus are prevented from germinating and producing the threads which grow into the tissues of the leaf. Well-sprayed haulms, instead of withering under an attack of blight, remain healthy and green; the crop is increased and the tubers themselves remain free from disease. It should be remembered that even the most careful spraying can never be so complete as to prevent all risk of infection, but it is nevertheless a very efficient safeguard. It should be regarded rather as a means of insurance, which will enable the plant to tide over the time during which it is most liable to infection. This period once well past, the work of tuber formation suffers no check, and the yield is larger than would have been obtained from a crop where the plants had been infected. The accumulated evidence of many years justifies the conclusion that, in an average season, the cost of insurance by spraying is amply repaid by the greater yield of healthy tubers.

Spraying too early is wasteful rather than helpful. With the exception of Devonshire, Cornwall and the neighbouring counties it is not usually necessary to begin spraying until the end of June or the beginning of July.

Further information regarding "Blight" and its prevention will be found in the Ministry of Agriculture's Leaflet No. 23, which may be obtained gratis and post free from the office of the Ministry, 3, St. James's Square, London, S.W. 1.

* * * * *

FRUIT growers and others interested in the preservation of fruits and vegetables, will, it is hoped, welcome a special

Fruit Preserving: educational scheme inaugurated by the Ministry. A new building situated in the heart of a fruit-growing district at Camp-

An Experimental School. den, Gloucestershire, has been equipped as an Experimental Station, to test, on a commercial basis, researches made in this direction. Home and commercial courses are to be inaugurated for the teaching of economic methods of preservation. A comprehensive syllabus for each course has been arranged.

Students taking the commercial courses at the Station will become familiar with the various processes which preserved fruit and vegetables undergo before being marketed. A distinct advantage is that the operations are on a factory scale. This course should be of great benefit to fruit growers, small holders and others interested.

In connection with the home preservation of fruit and vegetables, fortnightly "home" courses are being arranged for at the same Station.

A syllabus, covering a wide field of practice, has been prepared and can be obtained free on application to the Ministry of Agriculture and Fisheries, 72, Victoria Street, London, S.W. 1, or to the Secretary of the Ministry of Agriculture's Experimental Station, Campden, Gloucestershire.

* * * * *

FOR some months past experiments in the use of new materials and methods of construction for cottage building have been in progress on the Ministry's **Experimental Cottage Building.** Farm Settlement at Amesbury, Wiltshire. These experiments are now sufficiently advanced for certain particulars and conclusions to be communicated.

To enable public authorities and private individuals interested in housing matters to view the experimental buildings while construction is still in progress, the Ministry has decided to allow visits of inspection on Wednesdays during the next two or three months. On this day, the Building Manager or the Resident Clerk of Works will be in attendance to conduct visitors and explain any matters on which they may desire information. The Amesbury Farm Settlement adjoins Amesbury Station on the Salisbury branch line of the London and South-Western Railway.

Thirty-two cottages, forming part of the general equipment of the estate, are included in the present building scheme. The plans for these have been prepared by the Ministry's

architectural staff, but in the case of five cottages, based on one of these plans, the work is being carried out to the special designs of the Department of Scientific and Industrial Research. Direct labour has been employed for the erection of all the cottages except two, these last being erected under contract on proprietary systems of concrete block construction.

The accommodation provided in the cottages is similar in all cases, consisting of parlour, living-room, scullery, bath-washhouse, larder, fuel store, etc., on the ground floor, with three bedrooms over. Of the 32 cottages, half will be constructed in brick on normal lines, forming a standard of comparison for those built of other materials. The remaining 16, which may be classed as more directly experimental, are as follows :—

1. *Building in Pisé de Terre*.—The work at Amesbury consists of three single and one pair of cottages, all two-floor buildings. The walls of one single cottage are complete, and the structure is being roofed. This is the first two-storied pisé dwelling erected in England. The pair of cottages is in course of construction, and the foundations of the two single cottages have been completed. Experiments with various materials for rendering the external face of pisé walls have also been carried out.
2. *Building in Chalk on various Methods*.—The subsoil at Amesbury is chalk, and experiments with this material comprise :—
 - (a) A cottage with cavity walls, built of blocks made of chalk and cement.
 - (b) A cottage with walls of chalk and cement rammed between shuttering.
 - (c) A cottage with walls of chalk only (chalk pisé) rammed between shuttering.
 - (d) A cottage with walls of chalk and straw (chalk cob) built without shuttering.
3. *Building in Concrete*.—
 - (a) Two concrete block cottages with hollow walls, erected under contract by two proprietary firms, using new types of blocks and methods of construction.
 - (b) A cottage of monolithic reinforced concrete construction.
4. *Building in Timber*.—
 - (a) A pair of timber-framed cottages faced with elm weatherboarding.
 - (b) Two army huts converted into permanent bungalow dwellings. The huts were obtained direct from the contractor's yard, in a new and unused condition, but it would appear that no economy can be obtained by the use of these huts for permanent dwellings.

In all the cottages some interesting features in construction and fittings have been embodied. Experiments have also been made in exploring the practical and economical possibilities of subsidiary processes, on which, during wet weather, less skilled labourers can be kept employed under cover.

THE accompanying photographs illustrate the reclamation work which is being carried out by the Ministry at Wainfleet on the northern shore of the Wash.

**Land Reclamation
at Wainfleet.**

About 290 acres of salt-marsh, which is now submerged periodically, is being enclosed by a bank, as shown in the photographs, and when enclosed will be drained by one or more outfalls passing through the bank. It is expected that the enclosed marsh, when reclaimed, will be worth about £40 per acre, and it is proposed to utilise it in connection with a settlement for ex-service men which adjoins it.

* * * * *

It has been brought to the notice of the Ministry that in some quarters the shortage of basic slag is being attributed to

**Effect of Exports
on Supplies of
Basic Slag.**

the permission of exportation on a large scale. There is no foundation in fact for these reports. Export is prohibited except under licence, and the Board of Trade "Trade and Navigation Accounts" show that in 1919 only 13,699 tons were exported, which amounts to 2½ per cent. of the total quantity ground in that year. Similarly, for the first three months of 1920 the exports only amounted to 1,489 tons, about 1 per cent. of the total production. These percentages are much less than the proportion which manufacturers were entitled to ask for in return for their acceptance of the maximum delivered prices for basic slag in Great Britain. In the interests of agriculture they have, however, decided not to insist upon exporting the whole of the quantity which would have been licensed, with the result that the actual exports cannot be said to have accentuated the shortage of slag in any appreciable degree. Labour and transport trouble and such accidents as the destruction by fire of a steel works must be looked to for an explanation of the farmers' difficulties in obtaining slag; but these are now decreasing, and there should be better supplies for the 1920-1921 season. The prices fixed for ground basic slag during the season 1920-21 are stated on p. 296.

* * * * *

THE Minister of Agriculture, Lord Lee of Fareham, on 18th May received a deputation representative of agricultural members of the Workers' Union in the Home Counties. The Deputation was introduced by Mr. George Dallas.

**Farm Labourer's
Wage: Deputation
to Minister of
Agriculture.**

Lord Lee, in welcoming the deputation, expressed his anxiety that it should be realised that he and the Ministry were equally accessible to any

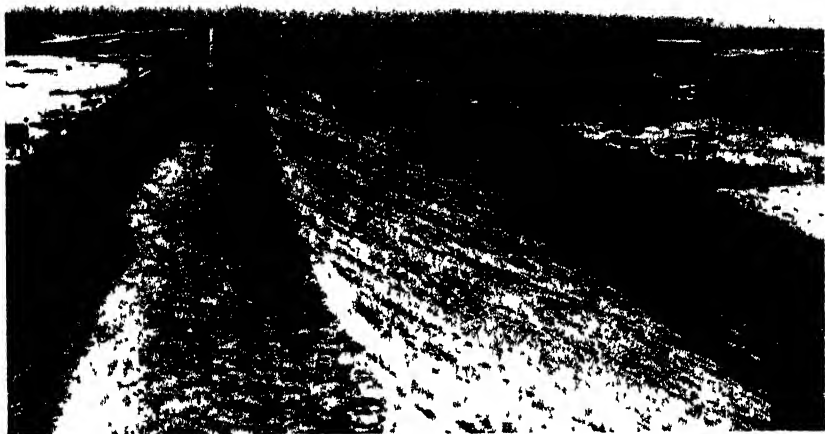


FIG. 1.—New Sea Bank. Wainfleet South. View looking north.



FIG. 2.—New Sea Bank: Wainfleet South. View looking north from junction with new Bystall Bank.



FIG. 3.—New Sea Bank · Wainfleet South. Abandoned work at south extremity of Bank.



FIG. 4.—New Sea Bank: Wainfleet South. View of firmer face of Bank taken from near junction with Bystall Bank.

and all of the classes interested in agriculture. He was specially interested in the general question of the relations between employers and employed in agriculture, because it reacted on the prosperity and output of the industry, and he was always glad to hear the views of all sides. He had no power to intervene, however, in local disputes, or to override in any way the considered decisions of the Agricultural Wages Board.

The deputation emphasised strongly that the wages of agricultural labourers were totally inadequate to meet the present cost of living. Agricultural labourers were a most patient and law-abiding class, but the situation was becoming more serious every day. Ex-soldiers who had returned to work on the land were, not unnaturally, comparing their lot with that of railwaymen, who were living perhaps in the next cottage and receiving £3 a week in addition to many privileges in the way of passes, uniform, etc.

It was urged that the cost of living was greater in the villages than in the towns, and a sample budget was submitted giving the bare necessities for a man, his wife, and four children, which worked out to 47s. 6d. a week. It was clear that an agricultural labourer could not bring up a family on the present minimum wage of 42s. 6d., and if the present position were not remedied the agricultural labourer would "down tools." It was sincerely hoped that a strike would be avoided, but if one took place, it would be a serious thing for the whole community.

Lord Lee, in reply, reminded the deputation that a proposal to increase the minimum wage to 50s. was at present before the Wages Board and would be considered at its next meeting. It was to that Board that their arguments should be addressed. He deplored the existing feeling of distrust between employers and employees, and urged the necessity of a spirit of conciliation on both sides. He had never hesitated to say that the conditions of agricultural labourers must be bettered, and that they should be paid a wage comparable with that of men working under the same rural conditions in other industries. Political pressure was in the direction of putting up wages in all industries, but unfortunately, so far as agriculture was concerned, that same political pressure was demanding cheaper food. It was difficult to render the labour of an industry more expensive and at the same time to cheapen its produce. At present the farmer had two alternative ways of using his land, and if he chose the perfectly legitimate form of grass-farming, with a consequent reduction of the labour he employed, there was

no legal power to stop him, however regrettable such a course might be. The only way to encourage arable farming was to make it more worth while.

Despite the lessons of the War, however, the urban consumer did not yet seem to realise the vital necessity of producing the maximum amount of home-grown food, or to regard the agricultural labourer as much a part of the essential life of the community as the workers in any other industry. Lord Lee pleaded for a better understanding between urban and rural population and for the partnership within the industry itself of labourers, farmers, landowners and everyone concerned with it. He believed firmly in the Wages Board principle of representatives of each side meeting together and trying to arrive at a reasonable agreement, and suggested that the labourers should try to arrange a conference with the Farmers' Union, at which they should support their case by reasons and facts, rather than by threats. Without a willing, prosperous, contented, and vigorous labour on the land, there could be no prosperity for the farming community.

* * * * *

THE Minister of Agriculture is empowered under the Inclosure Acts, 1845 to 1899, to effect exchanges of lands in England and Wales. Under these Acts landowners, whether limited or absolute owners, are enabled to avoid the necessity and expense of investigating the titles of the lands exchanged. The leading principles are that the lands exchanged shall be of equal value, and that the land received in exchange shall be held under the same title, and subject to the same uses, trusts, and liabilities, as was the land given in exchange. Upon the confirmation of an order of exchange, therefore, the land received becomes, with certain exceptions, clothed with the title and subject to all the liabilities of the land given up.

**The Inclosure
Acts and Tithe
Acts: Exchanges
of Lands.**

principles are that the lands exchanged shall be of equal value, and that the land received in exchange shall be held under the same title, and subject to the same uses, trusts, and liabilities, as was the land given in exchange. Upon the confirmation of an order of exchange, therefore, the land received becomes, with certain exceptions, clothed with the title and subject to all the liabilities of the land given up.

It is important to bear in mind that the exchange is made between the two titles and not between the applicants claiming title, who are merely, for the purpose of the exchange, "the persons interested," *i.e.*, generally speaking, the persons in actual possession. These persons may have no title, but nevertheless, provided they are "the persons interested," the exchange is valid as between the persons really entitled, and accordingly it must be such as may properly be made on the assumption that the applicants are not really entitled.

The Minister has no power to authorise a payment of money for equality of exchange. The only provision for compensating a deficiency is by the creation of a perpetual rentcharge, to be charged on the land of greater value, or a sufficient part of it, in favour of that of less value, but such a rentcharge can only be created where the deficiency which requires to be compensated does not exceed one-eighth of the value of the lands which are deficient.

The Minister is also empowered to effect exchanges under the Tithe Acts of glebe for other lands, and also of annual payments belonging to an incumbent in right of his benefice, and charged on lands or tithe rentcharge for lands or for tithe rentcharge. Application for such an exchange may be made by the spiritual person to whom such glebe lands or hereditaments belong in right of his benefice.

The objects and the results of exchanges under the Tithe Acts are similar to those under the Inclosure Acts. There is, however, no provision in the Tithe Acts under which equality of exchange can be effected by the creation of a perpetual rentcharge. The procedure under the Inclosure Acts is somewhat more elaborate than that under the Tithe Acts, and is more suitable for exchanges of large properties, even in cases where the exchange provisions of the Tithe Acts would be applicable.

Forms of application and instructions for exchanges, under either the Inclosure Acts or the Tithe Acts, may be obtained free of charge and post free on application to the General Secretary, Ministry of Agriculture and Fisheries, 3, St. James's Square, S.W. 1.

* * * * *

THE case for the vigorous destruction of rats rests on several considerations. They consume food, they spread infection

Rat Destruction. which is carried by fleas from the rat to human beings, and they are very destructive to buildings, where they gnaw floors and wood-work generally. Both from an economic and a sanitary point of view, therefore, it is highly desirable that these pests should be ruthlessly exterminated.

The destruction of rats is primarily a matter for local effort, and already many County and Borough Authorities, as well as private individuals, have shown praiseworthy energy. Of the 225 Local Authorities which, under the Rats and Mice Destruction) Act, 1919, became responsible for the execution

of this duty, more than 130 have appointed officers to administer the Act. Of these, 31 are special appointments of whole-time officers; to the remainder is entrusted the work of organising and supervising rat destruction in addition to their ordinary duties. The Ministry is in communication with those Authorities which have not yet appointed rat officers, and on these has been urged the necessity for making such appointments as those described. The Ministry also points out that the necessary measures can be organised on lines that are practically self-supporting. No cost falls of necessity on the general body of ratepayers. While substantial progress has been made since the Rats and Mice (Destruction) Act became operative, much yet remains to be done.

One gratifying feature of the work is the fact that the number of rat clubs is increasing. In Kent, the Rat Officer has increased the number of clubs from 14 to 72, representing 101 parishes. He is desirous, however, to see the whole administrative county adequately covered by these organisations. Lindsey, in Lincolnshire, has established 38 rat clubs.

The work done by Bristol during the Third National Rat Week is particularly praiseworthy. The Local Authority of the City applied for and distributed no less than 263,400 rat baits, exclusive of over 5,000 baits laid by the Rat Officer in docks, and 7,500 in sewers. During the same week, Exeter distributed over 6,000 rat baits, and Carmarthen County nearly 1,500, together with 2,500 mouse baits. The bills of rat mortality further include a record of 60,000 rats destroyed during seven months in Nottinghamshire, 18,000 in Dover during the past year, 41,000 in the North Riding of Yorkshire, and 80,000 in Hertfordshire, during a period of four months. In one of the metropolitan boroughs, where it was assumed that the number of rats was negligible, it was found, on investigation, that the borough was overrun. In one factory alone the damage to foodstuffs was estimated at £15 a night. The extent to which the rats thrive on the food they consumed is shown by the fact that some of the carcasses turned the scale at 2 lb. each. In districts where the food supply was not so plentiful, the weight averaged only 8 oz.

A Research Laboratory has now been established by the Ministry with the object of endeavouring to discover rat poisons that are not injurious to domestic animals. The aid of science is also enlisted to improve the poisons already in use.

OCCUPIERS are reminded of their obligations and liabilities under the Rats and Mice (Destruction) Act, 1919. It is important that every care should be taken to protect ricks, barns, and granaries from the ravages of rats. In urban districts defective drains are a frequent source of rat infestation, while slaughter-houses, bone-yards, refuse dumps, sewage works, and similar places are common breeding places, which should be kept as free as possible from rats by constantly taking measures for their destruction.

**Rats and Mice
(Destruction) Act,
1919: Some Simple
Suggestions.**

Where there is evidence of the presence of rats, the rat officer of the Local Authority, provided one has been appointed, should be consulted, or, if the occupier wishes to undertake destruction himself, one of the poisons containing squills or barium carbonate should be used. If there is no danger to other animals, or to human beings, by the use of stronger poisons, one of the standardised phosphorus preparations is generally efficacious.

To those who may desire to make their own baits, or have them prepared by the local chemist, the following recipes may be tried—

Recipes for Using Barium Carbonate and Squills.

- | | | | | |
|---------------------|----|----|----|-----------------|
| 1. Barium carbonate | .. | .. | .. | 6 oz. |
| Meal | .. | .. | .. | 16 " |
| Dripping | .. | .. | .. | 4 " |
| Salt | .. | .. | .. | $\frac{1}{2}$ " |

This makes 1,000 baits of 6 grains each (*i.e.*, pieces as large as a hazel nut).

- | | | | | |
|----------------------------|----|----|----|----------|
| 2. Barium | .. | .. | .. | 4 oz. |
| Biscuit meal or plain meal | .. | .. | .. | 4 " |
| Oil of aniseed | .. | .. | .. | 5 drops. |

Mix with fat to a paste, and lay out in pieces the size of a hazel nut in places where rats are known to be present.

- | | | | | |
|------------------|----|----|----|--------------|
| 3. Tallow | .. | .. | .. | 50 per cent. |
| Barium carbonate | .. | .. | .. | 50 " |

Mix with dripping to a thick paste and spread on cubes of bread the size of dice.

- | | | | | |
|--------------------------|----|----|----|--------------|
| 4. Squills, red powdered | .. | .. | .. | 20 per cent. |
| Bread | .. | .. | .. | 30 " |
| Fat | .. | .. | .. | 30 " |
| Syrup | .. | .. | .. | 20 " |
| Aniseed | .. | .. | .. | 6 drops. |

Crumble the bread, mix ingredients to paste and apply as in the case of Nos. 1 and 2.

"Gassing" Rats.—Sulphur dioxide, applied through a Clayton machine or in cylinders, as well as carbon-bisulphide properly applied, can be used to "gas" rats. Calcium carbide

to which water is added to produce acetylene gas, has also been found effective. A simple apparatus for destroying rats by the "gassing" method was described in this *Journal*, March, 1920, p. 1177. A reprint of this note may be obtained gratis and post free on application to the Ministry.

* * * * *

THE Ministry wishes it to be more generally known that members of the public, on payment of a small fee, may inspect

**Facilities for
Map Inspection at
the Ministry of
Agriculture.**

certain documents deposited with the Department. These documents include Apportionments of Tithe Rentcharge, Certificates of Redemption of Tithe Rentcharge and of Corn Rents and other money payments in lieu of tithes, Certificates of Capital Value of Extraordinary Tithe Rentcharge; and Awards of Inclosure and Regulation under the Inclosure Acts, 1845 to 1899. Other documents are Boundary Awards under the Inclosure Acts and the Tithe Acts; Schemes under the Metropolitan Commons Acts, 1866 to 1898; Orders of Exchange, Partition and Division of Intermixed Lands. It is desirable that applicants should, for their own convenience in the first instance write to the Ministry, giving particulars of the document it is proposed to inspect.

In addition to the documents mentioned, the Ordnance Survey Maps of Great Britain and Ireland on the scale of one inch to the mile, and those of Great Britain on the scale of six inches to the mile, may also be consulted. In this case no charge is made for inspection.

The Inspection Room, which is at No. 3, St. James's Square, London, S.W. 1, is open on week-days between the hours of 10 a.m. and 4 p.m., except on Saturday, when it is closed at 1 p.m.

* * * * *

AT the present moment, when the ratio of the cost of feeding to production shows such a small margin, the absolute nutrition

**Notes on Poultry
Feeding:**

*From the Harper
Adam's Agricultural
College.*

value of the various foods obtainable, rather than their price, should be the criterion of cost. Price is apt to be deceptive. During the past six months a considerable quantity of excellent poultry wheat has been obtainable at prices lower than, or equal to, mixtures of considerably less feeding value. Although wheat alone would not be a satisfactory feed, in conjunction with a suitably blended mash it should be more economical than the average mixtures at present obtainable, the latter being

for the most part dirty, stale and very expensive in view of their feeding value. Indeed, as matters stand at present it is better to omit mixed grain feeds entirely, and feed separate wheat, oats, and maize, in the ration of 2 : 2 : 1—that is, feeding wheat twice, oats twice, and maize once in every 5 days.

These grains, while being expensive, are likely to prove the most economical grain feeds now available. Samples are available at the following prices per cwt. for small lots, (wholesale prices would, of course, be cheaper) :—Wheat, 20s. ; oats, 23s. ; maize, 25s. At these prices the separate grain feeds are a good deal more economical than the available mixtures.

Turning to the question of mash feeds, at present prices bran, sharps, clover meal, crushed oats and fish meal in the following proportions, 1 : 9 : 2 : 2 : 4, mixed with whatever roots are available, will prove the most economical. Two parts maize meal may be added to the mixture if it is available, but at the present price of 27s. per cwt. it is a dear feed. There is no immediate prospect of food becoming cheaper, and in view of the winter scarcity of green food, clover meal at 12s. per cwt. is worth stocking. Prices for other offal in small lots are, per cwt. :—bran, 16s. ; sharps, 18s. ; crushed oats, 26s. 6d. Taking the year through an attempt should be made to keep the feeding cost down to the price of one egg per week per bird—that is to say, with eggs averaging 4s. per doz., feeding costs should not exceed 4d. per bird per week. This assures financial stability. In this connection the following table of the feeding costs at the Harper Adams Agricultural College Laying Trials may prove interesting, and it will be noticed that the ideal aimed at has not yet been attained. While feeding costs have averaged 4½d. per bird, eggs have only averaged 4d. each. This difference will probably be wiped out when the full 12 months' results are available.

*Feeding Cost in Relation to Egg Production (Per Bird),
1919-20.*

<i>Month.</i>			<i>Weight of Eggs.</i>	<i>No. of Eggs.</i>	<i>Value of Eggs.</i>	<i>Weight of Food consumed*</i>	<i>Value of Food consumed*</i>
			<i>oz.</i>		<i>s. d.</i>	<i>lb.</i>	<i>s. d.</i>
1st	..	..	16·4	8·4	3 5	6·7	5½
2nd	..	..	25·7	12 61	5 4½	6·6	10
3rd	..	..	28·9	14·19	6 0½	6·64	3½
4th	..	..	36·5	17·74	5 11½	6·54	4
5th	..	..	40·49	19·85	4 8½	6·62	2
5 Months Average			29·59	14·55	5 1	6·62	5

* Does not include Vegetables.

With birds on a free range considerable natural food is now available, and a corresponding "cut" can be made in the feeding costs. The amount fed per bird is often a matter of comment. In adult birds it should not exceed 4 oz. per day while laying, though it may be increased to the limit of the birds' appetite during a period of stress such as the moult. It will, however, be found in practice that about 4 oz. represents the maximum required, and this should not be exceeded.

As regards chick feeding, any unwise parsimony is apt to prove very expensive in the long run, and every attempt should be made to keep the young stock growing. Dry chick feeds are at present very expensive, and during the last month have jumped up about 20 per cent.—the price ruling for most samples being about 40s. per cwt. At this price they are too expensive, most of them consisting principally of broken wheat, maize and rice, and a considerable quantity of millet which is apt to be wasted. By far the most economical plan, if the material is available, is to mix the hard feed at home in the following proportions:—Wheat, 8 parts; rice, 2 parts, linseed, 1 part; maize, 2 parts; dari, 1 part; millet, 1 part; but in all probability the material will not be available, or difficulty will be experienced in having it properly kibbled. In this case, kibbled wheat will probably prove the best hard food. Chicks should be fed at least five times a day alternately on grain and mash feeds. A suitable mash can be made of sharps, oatmeal, clover meal and fishmeal in the proportions 8 : 4 : 2 : 1. It should be mixed with sweet separated milk, and a dash of charcoal may be added to each feed. If kibbled wheat only is fed as a dry food an addition can be made to the mash of boiled rice and linseed. The rice and linseed are mixed dry and then boiled or steamed and a small quantity added to each mash feed.

No definite weight of food should be allotted to chicks—care only being taken that no surplus is fed, and that everything is cleared up at each meal and that each chick has a fair share. The actual weight, however, will depend largely on the rate of growth maintained, the weather, etc.; and the chicks' appetite is by far the best guide.

AGRICULTURE DURING TWO GREAT WARS: 1793-1815 and 1914-18.

THE RIGHT HONOURABLE LORD ERNLE, M.V.O.

ON 18th June, 1815, the long war with France, which, with brief intervals, had lasted since February, 1793, ended at Waterloo. On 11th November, 1918, the Armistice terminated hostilities in another war which had continued for more than four years on a scale that had never been approached or even remotely imagined. It is natural to compare the two great struggles, and to see how far the experiences of the nation a century ago have resembled, or may be expected to resemble, those of to-day and to-morrow. History repeats itself; certain effects more or less invariably result from certain causes. But the main incidence, so to speak, of those results may be shifted by changes in social conditions. Prosperity and plenty, for instance, do not immediately return with the proclamation of Peace. On the contrary, history shows that a period of privation, which in severity and duration depends on the length of the struggle and the degree of financial exhaustion, always follows the cessation of war. But though this law is inexorable, and though some temporary and almost universal hardship is inevitable, the section of the community which suffers most severely is not necessarily always the same.

The causes of the two wars need not be discussed. There is between them one broad resemblance. Whatever may be said of the first stage of the long French War (February, 1793 to March, 1802), the second stage (May, 1803 to June, 1815) sprang from practically the same cause as led to our recent struggle against the Powers of Central Europe in 1914-18. With Bonaparte as first Consul, and afterwards as Emperor, France entered on a war of aggression. Against French domination in Europe the struggle became national. It was the uprising of nations which at length overwhelmed Bonaparte. So, in the recent War, Great Britain was struggling to preserve her independent national existence against the predominance of German autocracy and against gigantic schemes of military conquest and annexation. In both cases she was bound, whatever the cost of life and treasure, to persevere to her last man and her last shilling. But though the cause of both wars was practically identical, their course presents more of contrast than of resemblance. Two instances are enough. In the

French war we had not, and could not have, the gallant and invaluable aid of the overseas Dominions. From 1812 to 1814 the United States, instead of being our allies, were our enemies and at war.

In comparing our position at the two periods striking differences appear. Two points may be specially noted, the growth of our population and the increase in our resources. In 1801 the population of the United Kingdom was about 15,000,000; in 1811 it was about 18,000,000. In 1821, the first year in which Ireland was included in the Census, it was nearly 21,000,000. In 1911 the population of the United Kingdom exceeded 45,000,000, and thanks to their magnificent loyalty, we had, with us and behind us, the vast population of the Empire. Scarcely less striking is the growth of our financial resources. No complete figures exist to show the exact amount of the national income in the early years of the 19th century. But statisticians seem to accept as an approximate estimate a national income of £250,000,000, and it has been calculated that, of this total income, £120,000,000 were above and £130,000,000 below our pre-war Income Tax exemption of £160. Fuller and more reliable figures are available for 1914. There is substantial agreement on the estimate of a national income of rather more than £2,000,000,000, and on a division of this total income into £800,000,000 above, and £1,200,000,000 below, the £160 which was the pre-war limit of exemption from Income Tax. Thus the United Kingdom began the War of 1914 with a population which was three times greater than that of 1801, and with resources which were eight times as large. These two points must be borne in mind, if the national effort and the national burden of the two periods are compared.

Taxation and the National Debt.—When our ancestors entered on the French war (February, 1793) the National Debt amounted to nearly £234,000,000, and the entire public expenditure slightly exceeded £19,000,000. On 5th January, 1816, the Debt had risen in round figures to £864,000,000 and the expenditure of the preceding year exceeded £106,000,000. In April, 1914, the National Debt stood at £665,000,000, and the public expenditure for the year was estimated at £210,000,000. In April, 1919, the Debt had risen to £8,000,000,000, and the public expenditure of this present year is estimated to reach £1,400,000,000. Both in the French and in the German wars a part of the debt was incurred for loans and subsidies to Allies. In 1793–1815 the sum so expended was over £53,000,000; in 1914–18 it was £1,061,000,000. Even allowing for such

assets, the load of new debt was at both periods enormous. No country which is in such a financial position relative to its population and wealth can hope to escape a period of privations more or less severe. Such a period followed the French war. A similar period is bound to succeed the war with Germany. But the nation to-day is far better organised and equipped to distribute the suffering evenly. In the last century experience proved that the only remedy was increased production and economy. To-day, as then, there is no other way out. We must create the new earth before we can inherit the new heaven.

The burden of taxation must to some extent fall on all. But here a significant change has taken place. During the French war more than half the national revenue was raised by Customs and Excise Duties. This part of the burden fell upon consumers because the indirect taxation was levied on many articles of general consumption, such as salt, candles, soap, malt, and leather. A War Property Tax of 2s. in the pound was imposed from which incomes under £200 received graduated relief, and those under £60 a total exemption. Farmers contributed on the basis of profits calculated at three-fourths of their rack rents. Throughout the German war a different policy has been pursued. So far as possible, indirect taxation has been abandoned, and consumers generally have benefited by the relief. Direct taxation has taken its place. It has fallen on the richer sections of the community, who have met more than three-fourths of the current expenditure of the War. The following figures show the proportions of direct and indirect taxation (including excess profits as direct):—

		<i>Indirect.</i> <i>Per cent.</i>	<i>Direct.</i> <i>Per cent.</i>
Year to 31st March, 1917..	..	23·7	76·3
„ „ 1918..	..	17·3	82·7
„ „ 1919..	..	20·5	79·5
„ „ 1920..	..	27·96	72·04

Farmers have contributed on the basis of double their rents, with the alternative of paying on their actual profits. Equally significant is the post-war policy of taxation. In 1815 our ancestors abolished the Property Tax, which was the principal form of direct taxation in force during the War. In 1920 no relief is given to the richer sections of the community from direct taxation. On the contrary, the burden is increased and laid on fewer shoulders. This policy is undoubtedly the fairest, because the smaller the income the smaller the margin beyond necessities. But the result is that, the man who suffers

most is not the wage-earner. He has a substantial rise in wages but remains below £250, which is to be the limit of exemption from Income Tax. The load falls most heavily on the citizen who cannot increase an income which, though small, is liable to taxation. Between the two millstones of taxation and prices he will be ground "exceeding small." His life will be a struggle against real privations, embittered by the contrast with former comforts and by the use of those pitiful subterfuges that are necessary to maintain appearances.

The different policies pursued in respect of taxation, both during and after the French and the German wars, are significant of a profound change in the spirit of the 20th century. Another illustration of the same change of feeling can be traced throughout the agricultural history of the two periods.

Changes in Agriculture.—During the period 1793–1815 Great Britain was passing from an agricultural to a manufacturing nation. The transition began before the outbreak of war; it continued some years after the peace. A third of the people were still engaged upon the land, and from the land was, in 1814, derived a third of the gross assessments to Income Tax. But the population was rapidly increasing; it was withdrawing from agriculture, and shifting from the South to the coal and iron fields of the North; rural industries hitherto carried on in country cottages were being supplanted by textile machinery, and concentrated in factories. The enthusiasm for agricultural progress which had been steadily growing during the half century before the war, was at its full height. Large farms, large capital, long leases, and the most improved methods of cultivation and stock-breeding were the Gospel of the day. It was practised as well as preached. The division of labour was fast becoming an economic necessity. Agriculture, like manufacture, was ceasing to be a domestic industry. Both had to be placed on a commercial footing.

At any time, the social and industrial changes which were involved must have caused dislocations and required readjustments of existing conditions. Severe hardships were necessary consequences. Under war pressure, not only was the suffering aggravated, but the food problem was complicated. Foreign supplies of corn were obstructed. If any were obtainable, their prices were increased by heavy freights and insurances which; at war risks, rose from 30s. to 50s. per qr. To our ancestors the provision of bread-stuffs for a growing population, which was fast assuming an urban character, had become

a matter of extreme urgency. Under the tyrannical spur of necessity, great agricultural changes which were already in progress were crowded into the short space of 20 years. It was now that a large proportion of the rural population were severed from the use of the soil. This is not the occasion to discuss the Enclosure Acts which, during the war period, dealt with 4,000,000 acres of wastes and open field farms. Most people looking back on the past will recognise that though the action taken may have been necessary, and, in the majority of cases, legal, the law was often harshly interpreted, and that a golden opportunity was missed. To the community, the social loss was immense. The justification of enclosures lies in the facts that the necessities of the day required factories of bread and meat for the thousands who were gathering in manufacturing centres; that the fullest possible use of the land for the production of food had, owing to the war, suddenly become vital to the national existence; that the farming practices of the self-contained, self-sufficing communities of open-field farmers were a hindrance to this fullest use as well as to industrial development. All this is true. On the other hand, in the moral and social interests of the community, it would have been wise and easy to preserve the independence of the peasant by securing to him the use of a portion of the land.

To our ancestors, struggling in the throes of a great war, the provision of bread was the paramount consideration. Five years ago the present generation could scarcely have understood their position. Recent experience may have helped us to see more clearly with their eyes. What they dreaded was a deficiency of corn. The only foreign supplies that were available to meet a scarcity in our home-grown crop were grown under climatic conditions similar to our own. Harvests were simultaneously favourable or simultaneously unfavourable. If our home crop was short, the crops of Northern Europe were also short. There was no alternative source—for supplies from North America were so small as to be negligible—which was independent of our own adverse seasons. Provision against deficiency was, therefore, an essential feature of the Corn Laws from 1689 to 1815. The scales of regulating prices were frequently revised. But the principles remained the same. In normal years, when home prices kept below a certain level, imports of foreign corn were prohibited. When home harvests were abundant, exports were encouraged by a bounty. If the home crops were deficient, and prices rose above a certain level, exports were

prohibited, and foreign corn was admitted at reduced rates, or even at the ordinary poundage of 4*d.* per qr. It was believed that the system not only steadied prices, but reduced the risk of scarcity by encouraging farmers to maintain a larger corn acreage than in normal years was necessary to feed the population. Whether consumers gained or lost by the arrangement it would be difficult to decide. They were not cut off by Import Duties from any cheaper supply than their own, because from 1689 to 1765 English wheat averaged 4*d.* per qr. less than the price in Continental markets. Foreign corn, bearing the additional cost of freight and insurance, could rarely have reduced the price of English grain. On the other hand, in times of scarcity home consumers benefited by the large acreage under corn which was maintained by the bounty on exportation.

From 1765 onwards, under the pressure of a growing population, England gradually ceased to be an exporting country; in the last 35 years of the century her imports of corn exceeded her exports by over 22,000,000 qr. Throughout the French war the Corn Laws were practically inoperative. Liberty to export was continuously suspended. At the same time exceptional efforts were made to secure imports from abroad. For fear that private buyers might be deterred from buying by high prices, freights and insurances, agents on behalf of the Government shipped corn to this country from the Baltic ports; grain in neutral ships destined for foreign countries, was seized and put on the home market; heavy bounties were offered to importers of wheat.

Yet, in spite of these efforts, and in spite also of the high prices which prevailed in this country during the war, we only succeeded, from 1801 to 1816, in obtaining a yearly average of less than 600,000 qr. of wheat from abroad. For this comparative failure there were many reasons—such as the generally unfavourable seasons and consequently the universal shortage, the ravages of war, competitive buying by belligerent nations, the obstruction of the ports by political, naval or military complications. But the smallness of the figure is a significant proof of the success of farmers at home in meeting the national needs of a growing population. It was estimated in those days that the annual consumption of bread averaged from 8 to 6 bushels of wheat per head of the people. On this reckoning some 600,000 persons were each year throughout the period fed by imported wheat. In 1801, therefore, over 14,000,000 of the people, in 1811 over 17,000,000, and in 1816

over 18,000,000 were supplied—often inadequately, but still supplied—with bread-stuffs produced at home. In 1821, when imports had dwindled to an annual average on the preceding ten years of 450,000 qr., 20,500,000 people were fed from home-grown grain. One other point may be added. The unprecedented heights to which prices from time to time soared have seized on our imaginations and remained in our memories. The falls are forgotten. The following figures of prices afford another proof of the agricultural advance and the increased productiveness of the soil. They show that, when seasons were favourable, farmers, even after 22 years of war and with higher costs of production, could not only feed the people, but fed them with comparative abundance and cheapness :

<i>Date.</i>	<i>Wheat.</i>		<i>Barley.</i>		<i>Oats.</i>	
	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>
1792, December ..	47	2	..	29 10	..	18 6
1798, November ..	47	10	..	29 0	..	19 10
1804, March ..	49	6	..	22 9	..	19 9
1816, January ..	52	6	..	24 8	..	18 7

Agriculture and Weather Influences.—One lesson which the course of the war of 1793–1815 might well bring home to consumers is the dependence of the farmer on the weather. For many years past, the nature of the season at home has mattered nothing to the present generation of townsmen. If the home harvest failed, the urban consumer got his bread from a country where it had succeeded. He neither knew nor cared whether the home crop was large or small ; the loss fell on farmers, and he was in no way affected. But in the French war every man, woman and child knew what an adverse season meant. There was practically no alternative supply. A severe winter, a cold spring, a wet, sunless summer, even before their effect on the yield of the coming harvest was known, sent prices up and doubled the cost of bread. All England watched the weather as eagerly as the farmer, because between the weather and prices there existed the closest correspondence. It was the character of the season which, in the main, determined the price of the quartern loaf. The intimate connection between the two is hidden from us to-day by the method of recording the average yearly price of corn from 1st January to 31st December. The averages are thus made up as to two-thirds by the results of one season, and as to one-third by the results of another. No one who reads these averages would suppose that 1799, with its relatively low price of 69s., and 1813 with its high price of 109s. 9d., were respectively the worst and the best harvests within living memory.

Throughout the whole war period, seasons were adverse rather than favourable. Fourteen of the 22 were deficient, and, out of that number, eight (1795, 1797, 1799, 1800, 1809—10, 11, 12) were more or less disastrous. Six of the harvests produced average yields. Only two (1796 and 1813) were exceptionally fine and abundant. Bad years caused real scarcity. Twice (1799 and 1812) there was a dearth that almost amounted to famine. It was only in 1813 that the effect of the improved cultivation and increased productiveness of the soil was fully felt. The surplus of the harvest affected prices in the cereal years both of 1814 and 1815.

The Government did not attempt to control prices, or ration food. They probably relied on the high prices to check extravagance in the use of a scanty stock. Instead of cheapening bread by a subsidy from the taxpayer, they subsidised labour through the Poor Law. They not only legislated against trade combinations (1800), but, instead of trying to fix minimum wages, a Committee of Parliament reported (1808) that the proposal was inadmissible in principle, and in 1813 the law empowering justices to fix rates of wages was repealed. But the Government did endeavour to meet the scarcity of bread by some of the other methods with which we have been recently familiar. In 1795, for instance, stocks in hand were known to be short, and only 300,000 qr. of wheat could be obtained from abroad. The winter of 1794-5 had been exceptionally severe. A frost which began in December lasted till the middle of March. A cold, backward spring was succeeded by a wet and stormy summer. Though magnificent harvest weather temporarily raised hopes, the crop proved to be very deficient. The gloomy prospects were referred to in the King's speech of 29th October, 1795. Wheat at Michaelmas, 1795, stood at 92s. per qr.; at the following Lady Day it had risen to 96s.

Official Action during the Napoleonic War.—A Select Committee of the House was appointed to inquire into the scarcity, and measures were taken for its alleviation. By way of example, Members of Parliament bound themselves to reduce consumption in their own houses by one-third. The imposition of the Hair Powder Tax killed the fashion of plastering the head with flour. Bakers were authorised to use other ingredients than corn, provided that bread so mixed was stamped with "M." Privy Councillors and Aldermen tried to set the fashion of eating the coarsest forms of bread. But their efforts were only partially successful. The people clung tenaciously to the finest and whitest wheaten loaf. So severe was the scarcity that some

sections of the community were brought to the verge of famine. A rise in wages, and the distribution of funds raised by private individuals for the benefit of the poor, mitigated the misery.

But it was now that one of the most fatal blunders of the war was committed. The Poor Law was invoked to give relief. The Berkshire magistrates, meeting at Speenhamland, endeavoured to fix a "fair wage" by using the rates to supplement earnings in proportion to the price of bread and the size of the family. Their action, legalised by Parliament in the following year, was imitated by other counties. It was not till after the proclamation of the peace that the evil consequences of this well-meant action stood revealed. For the moment the fine harvest of 1796 restored abundance, and reduced prices, till in 1798 they fell back to their pre-war level. At subsequent critical stages in the food supply of the country further measures were added. Royal proclamations exhorted the people to economy; closer milling was adopted; the sale of bread was prohibited until it was 24 hours old; distilleries and starch manufactories were suspended; rice and maize were brought into the country to mix with corn-flour; potatoes were urged on farmers and their growth encouraged; bounties for the import of corn were continually raised in amount. It is, perhaps, worth recording that during two years of one of the worst periods of scarcity—1809-12—considerable supplies of corn were obtained from France with the consent, apparently, of the French Government.

Agricultural Prosperity in 1793-1815.—The war period was for landowners, tithe-owners, and farmers a time of great prosperity. An enormous capital was spent on the erection of farm buildings, houses and cottages, and on the improvement of the land by reclamation, and by the restoration of fertility to impoverished soils. It was now that, at an immense expenditure of money, much of the agricultural land of the country was, for the first time, made. New areas were forced into productiveness by the sheer weight of the metal poured into them. For the time the expenditure proved remunerative. It is probable that, within the 22 years of the war, rents were doubled, though much of the increase really consisted of interest on the new outlay of capital. In spite of high rents a new class of tenants—men of intelligence, enterprise, and money—were attracted to the land. Secured by long leases, they themselves carried out costly improvements. Land was marled, limed and drained. Whatever the science of the day could teach them was eagerly absorbed. New crops were introduced; new

manures were tried; new machinery and implements were purchased. More stock was kept, and it was both better bred and better fed. Money was made in farming. Both among landowners and farmers the standard of living was raised. Land rose in value. It was eagerly bought at high prices by farmers for their own occupation. Another class of buyers was attracted into the market; the advent of the speculator, or "land jobber" as he was then called, is noted.

Agricultural Labour after the Napoleonic War.—To labourers, who neither owned nor occupied land, the rise in prices brought no compensation. The increased cost of living was not adequately met by a corresponding advance in earnings. Cash wages undoubtedly rose substantially. Whether Arthur Young and Tooke are justified in claiming that they doubled may be doubted. There is some evidence that cash wages rose from 7s. to 12s. 6d. a week; but it is difficult to say with certainty that such a rise was universal. The most that can be said is that, so long as the agricultural activity lasted, there was no lack of employment at considerably enhanced wages. Had labourers still been able to supplement their increased cash earning by the use of land or by their domestic handicrafts, it is possible that, in spite of the high, but fluctuating, prices for food, they might have even bettered their position. But their rural industries were now employing thousands of townsmen in the factories, and the land, where they had gathered firing or run their live stock, was growing corn for the population of manufacturing centres. It was not till the war was over, when wages were falling and unemployment was rife, that the full extent of their irreparable loss was revealed. To landowners and farmers the 20 years that followed the end of the war were a period of falling fortunes and to labourers of misery, and moral degradation. To the whole agricultural community "Peace and Plenty" proved a delusion; to the agricultural labourer it was a cruel mockery.

Agriculture at the Time of the Great War.—During the recent war the story of British agriculture is fresh in our minds. It does not need to be retold. But the position of the industry and the policy adopted towards it at the two periods of the French and German wars are strongly contrasted.

Long before the close of the 19th century, Great Britain had been transformed into a manufacturing country. In the process, for good or for evil, agriculture had been sacrificed. Its interests had been subordinated to those of manufacture. It had dwindled in its relative importance as an income-tax-

paying and labour-employing industry. In 1814 the gross assessment to Property Tax of lands, tithes, manors and fines in Great Britain was little less than one-third of the gross assessments of all sources. In round figures it was £42,500,000 out of £137,500,000. It has stood still while other forms of property have advanced. In 1914 it remained at practically the same figure as it was a century before, while other sources had risen to over £1,000,000,000. Thus agriculture had dropped from one-third to one-twentieth. A similar change has taken place in the proportion of the agricultural population to the rest of the inhabitants. In 1814 a third of the people were agricultural. In 1914 nine-tenths were engaged in other industrial pursuits. Home agriculture no longer holds the same position in regard to the food supplies of the nation as it held in the early part of the 19th century. Its productiveness has declined, and, making every allowance for a higher standard of living, the decrease is probably actual as well as relative. In 1821 it grew the bread-stuffs of more than double the number for whom it provided in 1914. In 1821, also, it supplied the whole of the beef and mutton eaten in the country. Here it has probably made an advance. In 1914 it provided the fresh meat for some 25,000,000 out of a population of 45,000,000; but it largely depended on imports of concentrated feeding stuffs for the support of its live stock. The decline in its power, relative or actual, to pay Income Tax, employ labour, or produce food has been accompanied by a decrease in its political importance. Its influence during the French war may have been as disproportionately great as it is now disproportionately small. Be that as it may, the agricultural interest, which in 1814 was paramount, has lost the greater part of its political power.

Agricultural Policy during the Great War.—These changes in the agricultural industry have been necessarily reflected in the policy adopted towards the industry in the recent war. Agriculture has undoubtedly prospered, but its prosperity has been small as compared with that of the period 1793–1815. Farming profits have been restricted. The incentive of high gains which spurred the agricultural industry to such enormous efforts in the French war were not allowed to operate so fully in the recent struggle. Patriotism made as strong an appeal as the pocket. The great exertions made by home-producers in the face of unexampled difficulties were all the more creditable because, throughout the latter part of the German war, so much more was done for consumers than for

producers. The laws of supply and demand which, in the last 40 years, have been strictly enforced so long as they favoured consumers, have been set aside as soon as they favoured producers. Not unreasonably that has been a sore point with farmers.

Wheat may be taken as an illustration. In the French war prices found their natural level. They soared in years of deficiency; they fell in years of abundance. Farmers were compensated for the fall by the larger quantity which they had to sell. In the German war a flat maximum price was fixed which did not vary with the seasons. Whether the yield was large or small the price remained the same. What was a good price in a good year might become a poor one in a bad year. The whole of the loss fell on the farmer, and it is worth noticing that the harvests of 1917 and 1919 were most disappointing in their yield, while the disastrous rain in the late summer of 1918 ruined the quality of a large part of a magnificent crop. Meanwhile the 4-lb. loaf was stabilised at 9d. at the expense of the tax-payer. Foreign wheat was brought into the country at a much higher price than that which was fixed for home-grown. Every quarter of British wheat put on the market relieved the British tax-payer, who would have had to pay something like 25s. per qr. more for the imported substitute. Consumers benefited by eating a loaf which cost them at least 3d. less than its cost to the Government and the tax-payer.

In the French war, as already stated, the poorest consumers were subsidised out of the rates; in the German war, all consumers alike were subsidised out of the taxes. Throughout, the tax-payers' burden was reduced by restricting farmers' profits. The point has been little understood. It would be, in all the circumstances, reasonable that the Wheat Commission should publish in parallel columns the prices paid for home-grown and imported wheat during the period of control. It would be an act of tardy justice to British farmers. Probably the sum which producers of home-grown wheat have, in the years 1917, 1918 and 1919, saved the tax-payer, would be in the region of £25,000,000, and possibly more.

The flat rates for beef and mutton afford another illustration of care for consumers at the expense of producers. It was essential that the scanty supply should be so distributed that those who could, or could not, afford to pay high prices should get the same quantity and the same quality. The best and the worst meat commanded the same price in the British meat-

market. Consumers were satisfied ; but producers who were accustomed to supply high-class beef, mutton or lamb, suffered, and their flocks and herds were depreciated.

Other illustrations might be given of the preference given to consumers. Often, no doubt, the application of the process must have been exasperating to farmers. But there will be few who, when they look back on those times, will not recognise that it was the only principle to adopt. Its general operation certainly affords one of the most striking contrasts in the story of agriculture during the French and the German wars.

Contrasted Labour Conditions.—Another vivid contrast is offered by labour conditions at the two periods. During the French war agricultural labour seems to have been plentiful. Without an abundant supply, the work of reclamation and improvement could not have been effected. On the other hand, throughout the whole of the German war, the scarcity of agricultural labour narrowly restricted the increase of food production. So great did the strain become that by the middle of 1918 it approached to breaking point. The drain upon the manhood of the country for the naval, military and air services, and for the manufacture of munitions, exceeded anything that was experienced in the French war. As an illustration, the military forces engaged may be taken. At neither period was the nation prepared for war. In 1793, when revolutionary France put over a million of men into the field, our land forces amounted to 43,000 men in Europe, and 10,000 in India. In 1914 the total Regular Army of the United Kingdom amounted to something like 250,000 of all ranks, with which to stem the rush of the disciplined millions of Germany. At both periods we warmed to our work. In 1813, our Regulars and embodied Militia in Europe and India numbered 381,000. In the German war, if we measured our victories in trench warfare by the yard, we numbered our forces by the million. By the end of 1918, a total of 5,750,000 men of all ranks had passed into the armies of the United Kingdom. In this number and in the naval forces were included something like a third of the most able-bodied agriculturists of Great Britain, and there were many more who were drawn away from the land into other forms of civilian employment. With this reduced supply of skilled labour, the increased output of food which farmers succeeded in making was at once a notable achievement and a valuable contribution to victory.

Nor is it only in point of numbers that labour conditions have changed. During the French war agricultural wages were

substantially raised ; after the advent of peace they rapidly reverted towards their former cash level, with little or no increase in their purchasing power. It was a period when the whole rural community suffered together. But by far the worst sufferers were the labourers. During the German war, also, wages were substantially increased, and since the Armistice they have been further raised and the hours shortened. Nothing indicates more clearly the changed spirit of the times than the universal feeling that, as a result of the recent war, the position of agricultural labourers in this country must be materially improved, and not, as in 1816, materially worsened. If higher wages and shorter hours mean greater efficiency, the industry will prosper ; if they do not, the industry cannot thrive, or even exist, except under conditions which restrict employment. It rests with the men—and their leaders. Unless, as has been already said, a new earth is created, there can be no new heaven to inherit.

THE NATIONAL ASPECTS OF THE CASE FOR INCREASING THE SUPPLIES OF BASIC SLAG.*

Sir THOMAS MIDDLETON, K.B.E.,

Development Commissioner.

Food Produced by Soils of the United Kingdom.—From figures published in the annual volumes of statistics issued by the Board of Agriculture and Fisheries, and in the Report of the War (Food) Committee of the Royal Society, it may be shown that in the period before the War (1909–13) the soils of the United Kingdom were supplying products which, measured in terms of energy, would have sufficed for the support of about 17,500,000 persons. The whole population to be fed averaged about 45,250,000 persons; thus in each week the home supply would have sufficed from Friday night until Monday morning.

It is interesting to compare the position before the outbreak of war with the condition of the food supply during the last war in which the country was engaged. An examination of our imports in the early part of the nineteenth century shows that in 1801–10 the soils of the United Kingdom must have fed on an average some 16,500,000 persons. After Waterloo there was a rapid increase in our industrial population, and very great enormous pressure on the means of subsistence. In the period of reconstruction which followed the Napoleonic Wars the fare of the nation may have been meagre and was, no doubt, ill-distributed, and there was much hardship; but viewed from the standpoint of to-day, the feat performed by our farmers during that period was astonishing. By 1835 they maintained a population of 24,500,000 on the soils of the United Kingdom; in other words nearly 50 per cent. more than at the outbreak of the Great War.

Taking the soils of the United Kingdom as a whole, it may be shown that before the War farmers were providing for from 35 to 40 persons per 100 acres, and that in the period 1909–13 rather fewer than 17 persons were actually supported by the average 100 acres of our cultivated grass land. The figure for arable land, *i.e.*, under other crops than grasses and clovers, was calculated in 1916 at 84 persons per 100 acres.†

* Contribution to a General Discussion on "Basic Slags: Their Production and Utilisation in Agricultural and other Industries," held by The Faraday Society, Tuesday, 23rd March, 1920.

† The subject of the food supplies of the United Kingdom was discussed in a paper by Sir Thomas Middleton, published in this *Journal*, March, 1920, p. 1192. The figures given in that article may also be consulted.

I do not propose at present to argue out the national aspects of grass and tillage farming. Speaking from a farmer's standpoint, I am prepared to agree that in many parts of the United Kingdom the advantages of grass farming are obvious, for it must be remembered that the food problem as the farmer sees it is not the feeding of our 46,000,000 people, who have long ceased to be dependent on his efforts, but the feeding of his cattle, sheep, and other live stock. The two main human foods grown by the farmer—wheat and potatoes—occupied not more than 3,000,000 acres in the period before the War, while 36,000,000 acres were devoted to the crops required by his cattle and sheep. The value of the two tillage crops was about £27,000,000, while his live stock brought him in some £125,000,000.

Under these circumstances, the importance to the farmer of grass, the natural food of his live stock, needs no demonstration. Since grass is so important its present quality and the scope for improvement are points to which I wish to direct your attention.

The Scope for Improvement in our Pastures.—So far as I am aware, there are no trustworthy records from which the average production of meat by our finest permanent pastures can be estimated.

The best fattening pastures that I personally have met with are in the Market Harboro' district of Leicestershire, and I estimate that the richest field in the district, which I examined, would on an average of years produce from 180 to 200 lb. of meat without the assistance of oilcakes. The field in question fattened a bullock per acre in the early part of the grazing season, made a "forward store" without oilcake, or a fat beast with oilcake in the autumn, and, in addition, would provide some keep for store cattle or sheep in the winter months.

How many of our 33,500,000 acres of grass land come up to the level of the pasture described above? If one were to form an estimate from the newspaper controversies that centred round the ploughing up of grass land during the course of the War, one would probably be prepared to believe that about one-third, or possibly even one-half, of the grass land of England was of fine quality. In spite of the careful way in which the Agricultural Executive Committees in most cases selected land for ploughing, one heard constantly of their errors in destroying fine grazings to provide land for corn. Their task was to select no more than one-eighth of the grass land of England and Wales for ploughing, and although, notwithstanding their

efforts, less than 2,000,000 extra acres were in fact ploughed up, it was freely alleged that the live stock interests of the country were being jeopardised to provide wheat and oats. Clearly, if one believed all this war-time evidence, the pastures of England were a national heritage of great value. But let us test the position in another way. Is it possible that anything like one-third of our pastures can be up to the level of the "one-fat-bullock-per-acre" standard? What are the results of the grazing industry? The total number of grass-fattened cattle marketed in the United Kingdom does not exceed 1,000,000 per annum, and it is common knowledge that a large percentage of this number is fattened with the help of oilcakes. Personally, therefore, I should be surprised to find that there are, in fact, 500,000 acres of grass land in this country which, without the help of concentrated feeding stuffs, fatten one bullock per acre on the average of a series of years.

Now what about the other end of the scale? What yield may be expected from our poorest cultivated pastures—I do not refer to our 15,000,000 acres of hill grazings, which probably produce less than 5 lb. lean meat per acre per annum, but to our so-called cultivated land. My own estimate is that land of this type—poor clay soil pasturage very common in the North of England—yields from 15 to 20 lb. of lean meat per acre in the course of a year. Other experimental pastures in Northamptonshire and Cambridgeshire which I have had an opportunity of studying produced from 20 to 25 lb. of lean meat in an average season, and from the opportunities I have had of inspecting poor pastures in many parts of the country, I have come to the conclusion that there are very many thousands of acres of grass land in the United Kingdom from which the nation obtains no more than 25 lb. of lean meat in the course of a season.

With the information at present available, it is not possible to make any close estimate of the average production of meat on the pastures of the United Kingdom. In the first place, we do not know the total production. In the 5 years before the War it was estimated at 1,150,000 tons of beef and mutton, but with the more accurate information at the disposal of the Ministry of Food, it was found that in 1919 we produced some 875,000 tons only. There has been a considerable reduction in the number of sheep, especially of the larger sheep fed in the South of England, but the number of cattle is practically the same as in 1914. Feeding stuffs were scarce, and cattle were smaller than before the War. But when full allowance

has been made for these circumstances, it is not possible to resist the conclusion that we over-estimated out meat production in the period before the War.

Even if we knew the total output of meat, it would be necessary before estimating the production of our grass land to ascertain (1) the production from hill grazings, (2) the yield from the products of arable land, and (3) the amount due to imported feeding stuffs. Though it is possible to make more or less satisfactory guesses at the yield from each of these sources, it will be evident that no great accuracy can be claimed for the final result of an estimate that has in view so many uncertain factors. On the basis of the estimated pre-war production of meat, my former view was that the pastures of the United Kingdom produce on the average 100 to 110 lb. of lean meat per acre per annum, but at present I am disposed to think that 90 to 100 lb. would be nearer the mark.

Moreover, the meat of the "average" pasture is very different in quality from that produced on the finest pasture. The nutritive value of the lean meat of our "average" grazings is probably less than two-thirds of that of the fat meat produced on feeding pastures. Taking both the quantity and quality of the meat produced into account, it follows that our best pastures have about three times the value of our "average" pastures as sources of human food, while they may be 10 or 12 times more productive than the poor pastures that replace the former corn lands of many parts of the country. Anyone who has investigated the subject must agree that our pastures offer great scope for improvement. Let me illustrate the extent to which improvement may occur. In 1902 I laid out four 10-acre fields on the unimproved pastures at Cockle Park, Northumberland; basic slag and other manures were applied. This land in its unimproved state produces about 20 lb. of lean meat per acre per annum. Records have been kept ever since, and it is shown that on the average of two of the fields, and during the 11 years, 1904-14, the live increase made by cattle and sheep on these 20 acres was equal to about 105 lb. of meat per acre, or more than five times the yield of the untreated land. The special interest of this experiment is that the improvement was due to basic slag. The results of many other experiments might be cited to prove that on thousands of acres of this country the yield might be equally increased by the proper use of basic slag. The effect of the application of basic slag to some types of pastures is so striking that the results have been described as

magical ; but there is no " magic " in the action of the manure. This depends on the habit and manner of growth of white clover on land that has been depleted of phosphates by corn growing, and has then been left to " tumble down " to grass.

Most agriculturists will agree that, in conjunction with white clover, basic slag is the most potent agent known for restoring fertility to worn-out corn land. If the old corn-growing lands of England are again to take their place in producing wheat, it seems probable that one feature in the scheme of management to be adopted will be the alternation of corn-growing with a period during which clay soils will rest and regain fertility by growing clover manured with basic slag.

Effect of Pasture Improvement on Tillage Farming.—Apart from the uncertainty as to the future cost of labour, the chief obstacle to the expansion of tillage in this country is the difficulty that farmers would experience in devising means for supplying their live stock, were they to be deprived of any considerable proportion of the grass now grown by them. It is well known that, given the necessary skill and the command of capital and labour, food for live stock may be raised in greater quantity from land under the plough than from grass ; but it is certain that in many instances stock could not be kept so cheaply as they now are, were grass land to be broken up ; and it is further certain that the stock farmer would be less free from anxiety if tillage crops replaced his pastures. Any policy which aims at extending the corn fields of England must, therefore, reckon with strong opposition, if the increase of corn means the decrease of grass and hay. But it seems to me that the area under corn could be largely extended without reducing the natural foods of our live stock ; for, given enough basic slag, it would be an easy matter, in my opinion, to restore all the land well adapted for corn growing to tillage, and to grow as much grass and hay as we do at the present time.

In the early seventies of last century England and Wales had about 15,000,000 acres under the plough. Before the War the area had fallen to 11,250,000 acres. In 1918 it had increased to 12,500,000. Although labour is less plentiful and much more expensive than in the seventies, there should be no difficulty, given remunerative prices, in again reaching the 15,000,000 level, for in the interval the farmer's command of machinery and of manures have both greatly increased. In the immediate future the lack of buildings must prevent any considerable extension of tillage, but a time will come

again, it may be anticipated, when builders will be glad to secure work, and when materials will be forthcoming. It is, I think, beyond dispute that 15,000,000 acres of land suited for tillage could be found; what the farmer argues is that in view of the increase in his herds he could not carry on his business with 12,000,000 acres of grass only in England and Wales; he wants to have the 16,000,000 he had available in 1914. As I have already indicated, I admit the difficulty. I do not say to him: "The extra 4,000,000 acres under tillage would feed as many animals as the 4,000,000 acres grass ploughed up." In theory they could do so; in practice the farmer might not succeed in the attempt. What I should prefer to say is: "Given manure and reasonable management, there will be no difficulty in growing as much grass and hay on 12,000,000 acres in future as you produced on 16,000,000 before the War."

Let us further examine this statement.

Of the 16,000,000 acres under grass at the outbreak of war there may have been 1,000,000 so good that no marked response to manuring could be expected, and 3,000,000 on soils so dry and arid that no scheme of manuring would prove profitable. This would leave a balance of 12,000,000 acres susceptible of profitable improvement. In view of the wide extent of our clay soil and chalk pastures, and the extraordinary response which most pastures and meadows on such soils make to the application of basic slag, it seems to me to be reasonable to assume that if 4,000,000 acres of these permanent pastures were ploughed, the remaining 8,000,000 acres could produce as much grass as is now being grown on the whole 12,000,000 acres.

Value of Extra Tillage Land to the Nation.—The value to the community of these 4,000,000 extra acres under the plough would be much greater than at first might be supposed. The full effect is not apparent from the simple proportion, 11 : 15.

Opponents of a plough policy usually start off with the assumption that the corn-growing capacity of Britain in proportion to her needs is so small, that any effort which might be made to increase home supplies would have negligible results. This assumption is far from being correct.

I estimate that if the necessity arose, and all the products of the soil were carefully rationed and efficiently distributed, the present population of the United Kingdom could be supplied with breadstuffs from the produce of about 14,000,000 acres of corn. Towards this total England and Wales would be required to contribute 10,000,000 acres. Now, with 11,000,000 acres under

the plough, as in the pre-war period, and with the system of farming then current, we would normally grow 5,750,000 acres of grain. Should high prices continue to rule, it is probable that 6,250,000 acres would be forthcoming. With 15,000,000 acres under the plough, we would grow from 7,500,000 acres when corn prices were low to 8,500,000, or even 9,000,000, when prices ruled high (the average for the period 1871-75 was 8,100,000 acres). Should danger arise, it would be impossible to secure 10,000,000 acres of corn in England and Wales, if we started, as in 1914, with no more than 11,000,000 acres of tillage land. In spite of the great effort made, we got only 7,500,000 acres in 1918. But if we began with 15,000,000 acres of tillage in hand, our task, though formidable, would be by no means impossible. An extensive grass-ploughing campaign would, no doubt, be called for, but we should start on the effort to secure 2,000,000 or 3,000,000 extra acres of corn, with the buildings, the men, the horses, and the machinery which 15,000,000 acres of tillage would support in time of peace, instead of with the men and equipment of 11,000,000 acres.

In a war crisis, therefore, these extra 4,000,000 acres of tillage land would mean the difference between the provision of a sufficient, if meagre, supply of breadstuffs for the whole population, and a curtailment of the supplies that would lead, in the first place, to a breakdown of the machinery for rationing and later to famine and to the popular ferment that would inevitably seize a people deprived of a sufficiency of bread. It would mean the difference that there was between our own comfortable, if somewhat unattractive, diet in the last two years of the War, and the makeshifts on which our enemies attempted to fill, but failed to feed, themselves.

But, it will be argued, "why prepare for another great war when we have made an end of great wars, and why suppose that if there is a war, imports will not reach us with as great certainty as they did between 1914 and 1918? We have shown how to defeat the submarine, and we can safely rely on our Navy and merchant vessels in any circumstances that may arise." Let us admit this contention, even if we feel the argument to be unconvincing, and examine the case for the extra 4,000,000 acres as a peace proposition.

On the lavish scale on which this rich nation fed itself and its live stock in the period 1909-13, I estimate that some 21,000,000 acres growing "average" (i.e., average British) crops would be wanted to supply the cereals consumed in the United Kingdom. The area under these crops in the United

Kingdom in 1909-13 was between 7,500,000 and 8,000,000 acres. About 2,000,000 acres were contributed by Scotland and Ireland. As I am discussing the subject from the standpoint of England and Wales only, we may assume that their share in the 21,000,000 acres that would be called for if all our cereals were home grown, would be between 17,000,000 and 18,000,000 acres. The actual contribution made by England and Wales in the period 1909-13 was 5,800,000 acres. Under the influence of high prices this area might be increased to 6,250,000 acres, *i.e.*, to 36 per cent. of the area required for a full supply.

Having regard to the large proportion of our area under permanent grass, and the demands which live stock fed on poor grass land necessarily make on the products of arable land, it is unlikely that even if corn prices remained at the present high level and the shilling loaf were permanent, we would have more than 6,500,000 acres under grain.

Under the conditions which I have postulated for an arable area of 15,000,000 acres, the limits of corn growing would be wider. I have assumed the improvement of some 8,000,000 acres of pasture by 50 per cent. What I meant to convey was that 8,000,000 acres of grass could be made capable of carrying 50 per cent. more stock during the summer season, and of producing 50 per cent. more hay. But there would be a second important result of such a change. An improved pasture has a much longer grazing season than an unimproved; the grass comes earlier and lasts later; thus, assuming the same numbers of cattle and sheep to be kept through the summer on similar areas of improved pasture that had previously been kept on 12,000,000 acres of unimproved land, there would be a smaller demand for winter keep in the one case than in the other.

A second circumstance favouring wider variations in the area reserved for corn growing with a total of 15,000,000 acres arable land than with 11,000,000 should be pointed out. The additional 4,000,000 acres would, for the most part, consist of the heavier soils; these are more expensive to till, and when supplies of grain were abundant and prices low, a long rotation would, and should, be adopted. I say "should," because it is just these soils that, with the assistance of basic slag and white clover, might very profitably be laid down to temporary leys. When supplies were scarce and prices rose, this same land would stand a good deal of intensive corn growing. Thus I estimate that while with 15,000,000 acres of arable land the probable area under grain would vary from 7,500,000 to 8,500,000 acres, the upper limit,

If favoured by a wise national policy, might well reach 9,000,000 acres. If, however, we adopt the more conservative figure of 8,500,000 acres under grain, we should even then increase our home supplies by 12 to 14 per cent. An increase of this amount would not only substantially diminish our foreign purchases, but would tend to reduce fluctuations in price; for, in spite of the abuse which we bestow on our British climate, it seems to me that our own harvests may well fluctuate less in amount than the average of the exportable surplus of the harvests from which we must draw our future supplies. This is not the time to discuss the prospects of our future wheat supply, and I cannot pretend to have an expert knowledge of the wheat trade; but when I look to the sources from which our supplies were drawn in the past, to the effect which war has had upon the soils and the labour that produced our wheat, and to the great fluctuations in yield due to climate, it does not seem to me that a nation which depends so largely as we have done in the past on "exportable surpluses," can escape great fluctuations in the price of bread.

Occasional high prices, even frequent high prices, will not in themselves secure a permanent addition to the area under tillage. Other measures are called for, and among the most important is an effort to increase the output of basic slag, so that the quality of our grass land may be improved.

To the steel maker the slag which he produces is no doubt a secondary consideration, but I hope that his concentration on improvements in the manufacture of steel will leave him with time and inclination to bestow attention on processes by which the quality and output of basic slag may be increased. I have endeavoured to direct attention to the national importance of basic slag, and I hope I have succeeded in indicating that its manufacture is not merely of interest to the farmer as a means of providing a profitable manure for his pastures, but that it has a direct bearing on the future of the bread supply of those engaged in the steel industry and of their fellows in our other industries. The conditions affecting the food supply of the industrial classes are very different from what they were in 1820, but let us not forget that they are also very different from what they were in 1914. The extent to which our urban population may be driven to rely for their supplies of food on the soils of this country cannot be foreseen. We must not too confidently assume that all that we ask for will be supplied by other countries. There may still be "hungry forties" ahead of us.

THE "ROYAL'S" WAR RECORD.

J. P. GOODWIN.

THE Royal Agricultural Society of England can fairly claim to have carried out no less satisfactorily during the years of war than in those of peace the task allotted to it 82 years ago—the general advancement of English agriculture. It will not be denied that the farming industry has made great progress under the stimulus of the "Royal," and more especially in the improvement in live stock and in agricultural machinery, due to the competitions and demonstrations at the Society's annual shows. With the exception of 1866, the "Royal" show has been held annually down to 1917, in which year, and the one following, the critical state of the War led to its abandonment.

Thus compelled to rest from one of its chief labours, the Society endeavoured to assist in the solution of the problems born of the exceptional times. The Council therefore appointed a War Emergency Committee for the following purposes:—To advise the Government Departments, if they so desired, by focussing the opinion of agriculturists all over the country; to give confidence to agriculturists by providing a body which could help to solve many of their present difficulties and 'ake up their just grievances; to reassure the public by devoting its attention to the maintenance of the food production of the country; to sift the proposals being put before the country as to what should be done with the land, and to consider the effect of Government orders and regulations on production.

The Society consistently sought to assist the Government, and more especially those departments concerned with the fixing of prices, which were particularly in need of expert and unofficial guidance. One effect of the Society's work in this direction was to reassure the public, for it was recognised that a practical body of men was devoting its attention to the maintenance of food production. Another result was to show that the patriotism of the farmer was as genuine and deep as that of any other class. Prompt and emphatic protest on the part of the Society against the charges of apathy and profiteering which were sometimes laid at the door of the farmer had the effect of securing a fairer field for harassed agriculturists, and strengthening confidence. At the same time the Council urged the farmer to make the utmost use of such facilities

as were available, and to exercise economy in the use of feeding stuffs, while it gave the weight of its influence in support of the official campaign for food production and food saving.

One of the earliest resolutions of the War Emergency Committee uttered a caution against the excessive ploughing up of grass land, and the Society had the satisfaction of securing a declaration by the authorities that grass land which was fully productive for milk or fattening cattle should be left down, although it was not always possible to adhere rigidly to this principle. It was also urged, with ultimate success, that the ploughing up of grass land should be accompanied by the establishment of guaranteed prices for cereals for a period of years. From the very beginning the "Royal" insisted that the prices fixed for the farmer's produce should be based upon the cost of production plus a fair margin of profit, and that the cost of such essentials as feeding stuffs and fertilisers should also be fixed. In the same way the Society, by the recommendations which it made to the Government, was successful in securing concessions which were not only of direct benefit to the farmer but ultimately in the interests of the country as a whole.

In a still more direct way the Society took part in assisting the Government by nominating members to act on several of the official Committees set up to advise as to the probable operation of contemplated measures of control. In particular the Society's representatives on the Central Advisory Council did most valuable work in reconciling, as far as possible, the demands of the consumer with the requirements of the producer.

Agricultural Relief of Allies.—Another important feature of the Society's war work was the inauguration of the Agricultural Relief of Allies Committee. From the outset English farmers felt the deepest sympathy with the agriculturists in Belgium, France and Serbia in the ruin and suffering imposed upon them by a merciless invader. It was therefore fitting that the "Royal" should come forward and give cohesion to the help offered throughout the country to enable the Allied farmers to resume cultivation of their holdings when the opportunity should arrive. The lead given by the Society was in keeping with its action in 1870-1, when it established a fund for supplying seed corn to the peasants in the northern and eastern regions of France, whose crops had been destroyed in the Franco-Prussian War. With His Majesty the King as Patron, the Agricultural Relief of Allies Committee came into existence

in 1915. The Breed Societies, the Central Chamber of Agriculture, the National Farmers' Union, and practically all the county agricultural associations joined heartily in the movement, and the Committee became representative not only of every phase of agricultural activity in this country but of Dominion agriculturists as well. A start was made with relief work in the Marne and Meuse in 1915 in those districts liberated by the first victory of the Marne. A large number of Southdown rams, including five given by the King, many ploughs, harrows, cultivators, drills, and binders, as well as considerable quantities of seed corn and seed potatoes, were sent and distributed.

The Committee's opportunities for relief, however, diminished when the War became an affair of trenches and long-range artillery, and although small shipments of seeds, live poultry, and fruit trees, were sent to France while fighting was still in progress, it was not possible to embark upon the main programme of relief until after the Armistice in November, 1918. By that time the Fund had been raised to over £200,000, this sum being obtained very largely by means of gift sales organised in the principal agricultural centres by the county committees.

In France and Belgium it was decided to restrict operations to districts where the agricultural industry had most seriously suffered, and in each case these happened also to be districts which British soldiers had defended—the Department of the Somme in France, and the Valley of the Yser in Belgium. The great need in both regions was for a supply of milk, the Belgian district in particular having previously been renowned for its dairy produce. In the Somme, however, there was an absence of buildings for the accommodation of cattle, and the Committee therefore sent consignments of pigs and poultry at first, and did not distribute any cattle until June, 1919, when the situation had sufficiently improved to justify sending such stock. In Belgium, on the other hand, there was, behind the actual battle-front, accommodation for dairy stock from the first, and within four months after the Armistice the Committee had placed over 300 head of British dairy cattle on the pastures of devastated Belgium. Other cattle, together with sheep and pigs, followed in both countries, and the Committee has received abundant evidence of the important part played by its gifts in the work of reconstruction. A matter for satisfaction is the care which has been bestowed upon the animals by their new owners, and with very few exceptions

the British stock has done extremely well. About 600 dairy cattle and 2,000 head of poultry were sent by the Committee to Serbia for distribution in the neighbourhood of Shabatz, and a number of poultry were given to Polish peasants.

The Scottish Committee for Belgian relief, formed by the Highland and Agricultural Society, co-operated with the Relief of Allies Committee and sent a splendid lot of Ayrshires to the Pervyse district of Belgium, while a Canadian sub-committee has given large quantities of small tools to Allied peasants who have returned to their battered holdings. The amount given by the Committee is indeed small in comparison with the vast extent of the damage, but the policy of concentration has ensured that the relief shall constitute a lasting memorial of the practical help of all British agriculturists whose generosity the Society had the privilege of co-ordinating and making effective.

The following shows at a glance the relief given by the Committee since the commencement of the Fund:—

	<i>France. Belgium. Serbia. Poland.</i>				<i>Total.</i>
Bulls	55	50	30	—	135
Heifers	782	790	550	—	2,122
Rams	231	65	—	—	296
Ewes	1,795	1,475	—	—	3,270
Boars	45	63	—	—	108
Gilts	471	593	—	—	1,064
Goats	2	413	—	—	415
Poultry and Eggs for hatching	7,042	7,664	2,000	362	17,068

In addition, 151 agricultural implements, such as binders, ploughs, etc., together with 3,700 sacks of seed corn and potatoes, and 8,850 fruit trees, were sent to France.

PROFIT AND LOSS SHARING IN AGRICULTURE.

JAMES WYLLIE, B.Sc., N.D.A. (Hons.).

THE publication of the writer's Scheme of Profit and Loss Sharing in Agriculture in this *Journal** and elsewhere has created considerable discussion, not only as to whether the Scheme proposed is sound in principle but also as to its practicability. The question of principle will always be a matter of opinion, but it is likely that as many employers, and especially farmers, will cavil at the practicability of profit and loss sharing as at the principle involved. Indeed, a common objection amongst farmers is that profit and loss sharing implies not only that accurate accounts must be kept but also that they must be regularly audited by a qualified person. In these circumstances a useful purpose may be served by showing how the Scheme would and does work out in practice.

1. The Balance Sheet.—The foundation of any profit and loss sharing scheme is a properly constructed balance sheet showing, *inter alia*, the actual amount of capital invested in the farm. Since capital is one of the factors to be remunerated, the amount must be accurately determined. In particular, the valuation of stocks in hand must be neither too high nor too low, while the amount included for cash at the bank should not be more than is necessary to carry on the farm as a business proposition. Except in special circumstances (which, it may be said, will quite frequently arise), the valuation should be made either according to standard or fixed values, as in the case of sheep stocks, dairy herds and working horses, or on the basis of estimated cost of production or market value, whichever is the lower. It is highly desirable, and will make for confidence amongst the employees, that the valuation be made by a disinterested party, and that the balance sheet be properly certified.

2. Rate of Interest on Capital.—At the outset an agreement should be arrived at between the employer and the employees as to the rate of interest which is to be allowed on the invested capital. Under present conditions it is suggested that the

* See Vol. XXVI. No. 9, December, 1919, pp. 510-513, which should be read with this article.

rate should not be less than 5 nor more than 7 per cent. per annum. These limits are put forward for the principal reason that employees are not likely to agree to more than 7 per cent., while the employer is not likely to accept less than 5 per cent. per annum, and it is more important to have agreement than to attempt to justify a certain rate by reference to the riskiness of farming as a business, or by pointing to prospectuses offering 8, 9 and 10 per cent. per annum on what are called Preference Shares.

3. **Accounts.**—For the purposes of profit and loss sharing, nothing but a simple system of accounting is required, but a complete record should always be kept of the wages paid to each hired worker. Particulars should also be kept of all ordinary manual work done by the farmer or by members of his household, and it is desirable that a weekly or monthly record should be kept of farm produce consumed in the farm house.

4. **Employees' Wages.**—The main object in this connection is to ascertain the total *earnings* of all the hired workers, including cash wages, payments in cash for overtime, harvest, lambing, etc., and perquisites or allowances of all kinds—cottage and garden, board and lodging, potatoes, milk, oatmeal, etc. Perquisites should generally be valued on the basis laid down by the Central Wages Board, but there is, of course, no reason why the employer and employees should not agree upon another scale. The scale adopted here should also be used in valuing farm produce consumed in the farm house. Profit and loss sharing would be simplified if all wages were paid in cash. It will be clear that the inclusion of perquisites or allowances at this point is necessary, not to enable the profit to be accurately determined (for this is not affected), but to enable the profit to be equitably distributed.

5. **Employer's Wages.**—This term is used to cover the value of ordinary manual work done by the farmer or by members of his household, as well as for his services as manager of the business. Manual work should be charged at current rates for hired labour of the same class, while the charge for management should be based upon salaries actually paid to farm managers in the district. The main desideratum here, again, is that there should be agreement as to the rates and total amount to be charged for employer's wages, and, in any case, employer's and employees' wages should rise or fall together.

6. *Farm Credits.*—The farm must be credited with the estimated annual value of the farm dwelling-house as well as with all farm produce used in it.

7. *Profit or Loss.*—The profit to be distributed (or the loss shown) will appear after making the adjustments above indicated, that is, after charging the farm with (a) Interest on Capital, (b) Employees' Wages, and (c) Employer's Wages—the rest of the accounting being on the usual lines.

8. *Example.*—The following example may now be given to show how the Scheme would work in practice. On a certain farm accurate accounts have been kept since 1905, and the summarised results for the last two years were as follows:—*

<i>Year ending Michaelmas.</i>	<i>1918.</i>	<i>1919.</i>
	£	£
Receipts during year	4,064	3,752
Capital at end of year	4,765	4,775
	<u>£8,829</u>	<u>£8,527</u>
Capital at beginning of year	3,947	4,765
Payments during year	3,992	3,342
Balance	890	420
	<u>£8,829</u>	<u>£8,527</u>
Cash wages paid	<u>£619</u>	<u>£874</u>

For profit and loss sharing purposes the following adjustments would be necessary:—

	<i>1917-18.</i>	<i>1918-19.</i>
	£	£
(1) Cash wages paid	619	874
Add Rent of two cottages (only perquisites)	10	10
<i>Total Employees' wages ..</i>	<u>£629</u>	<u>£884</u>
To be divided into—		
Wages paid to "ineligible" workers	40	64
Wages paid to "eligible" workers	589	820
	<u>£629</u>	<u>£884</u>

- (2) It was agreed to allow the farmer £300 per annum for management, while the work of two sons was valued at £125 in 1917-18 and £160 in 1918-19, hence total *employer's wages* was £425 and £460 in 1917-18 and 1918-19, respectively.

res given to the nearest £1.

	1917-18.	1918-19.
	£	£
(3) Balance as shown above ..	890	420
<i>Deduct</i> : Interest on Capital at 5 per cent. ..	197	238
Employer's wages ..	425	460
	<u>622</u>	<u>698</u>
	268	(-) 278
<i>Add</i> : Rent of farm house ..	20	20
Farm produce used in house ..	80	110
	<u>100</u>	<u>130</u>
	368	(-) 148
<i>Deduct</i> : 10 per cent. to Reserve Fund ..	37	—
<i>Actual Amount for Distribution</i> ..	<u>£331</u>	<u>—</u>
(4) Proportion allocated to Employer, viz. :—		
425 of 331 ..	= 133	
629 + 425		
Proportion allocated to ineligible Employees (to be added to Reserve Fund), viz. :—		
40 of 331 ..	= 13	
629 + 425		
Proportion allocated to eligible Employees, viz. :—		
589 of 331 ..	= 185	
629 + 425	<u>£331</u>	

The net result, therefore, in 1917-18 is that £50 (£37 + £13) is placed to reserve, while the employer gets £133 and the employees £185, both sums being paid in cash.

This latter sum has now to be distributed over the eligible workers according to the total earnings of each as shown by the wages record. In this case there were 11 workers regularly employed, so that the average share per worker is about £17, or 6s. 6d. per week.

So far as the year 1917-18 is concerned there has been no difficulty, for the principal reason that there has been a surplus profit to be shared. What about 1918-19, however? Here there is a deficit, for profit sharing purposes, of £148.

As a pure matter of logic, it might be urged that this loss should be shared on essentially the same lines as the profit, i.e.,

between the employer and employees. On the other hand, any such proposal would effectively ruin the scheme in the eyes of the workers, and in any case it must be recognised that wages cannot be expected to *fluctuate* in the same way as profits.

In such circumstances as the above the writer has proposed to carry forward the deficit to the year 1919-20 and make it a first charge on the surplus shown for that year, or, the reserve fund may be drawn upon to cancel whole or part of the deficit.

9. The Reserve Fund.—It is clear that the most critical time in the life of a profit and loss sharing scheme is the period which elapses before the reserve fund has reached an amount large enough to meet the contingency which has here arisen. Various methods of meeting this difficulty have been suggested, such as the creation of a reserve fund by the employer at the commencement of the scheme. On a broad view of the case, however, it is obvious that unless such a scheme can be completely self-supporting *over a period of years* it cannot possibly survive for very long. In other words, the scheme ought to resolve itself into a *profit-sharing* scheme. Losses there may be in occasional years or even in successive years, but unless the profits exceed the losses by an appreciable amount over a period of years nothing can save the scheme from speedy extinction.

It may be useful, therefore, to take the results from the farm in question and show how a profit-sharing scheme would have worked out had it been in operation since 1905. These results are summarised in Table I. (p. 260.)

10. The Scheme for 14 years.—It is evident that had the scheme started in 1914 the reserve fund in 1918 would have been large enough to tide over the year 1918-19. In the table, the deficit of £148, together with sufficient to pay a 5 per cent. "dividend" on wages, viz., £64, has been drawn from the reserve fund, which at Michaelmas, 1919, stands at £334. Had the reserve fund been larger it would have been possible to pay up to 10 per cent. on wages, but in view of the previous experience it would appear to be unwise to make too severe a call upon the reserve fund.

In considering this table attention may be directed to the following points:—

- (a) A profit and loss sharing scheme was not actually in operation on this farm,
- (b) The *Balances* shown and the cash wages paid are as given in the accounts, but the adjustments which have been made are not necessarily those which

would have been agreed upon between employer and employees. This latter fact, however, does not detract from the value of the table as an illustration of the principle of profit and loss sharing.

- (c) It is clear that had the scheme started in 1909-10, it would almost certainly have failed, simply because there were no profits to share for a period of 4 years in succession. On the other hand, a start in 1905-06 might have enabled the scheme just to survive the lean years of 1909-10 to 1912-13, for by this time the employees would have felt the benefits during 1905-06 to 1908-09.
- (d) In any case, it must be emphasised that if the objects of profit and loss sharing had been realised, not only would the profits have been greater in the good years but also the losses would have been less in the poor years. The table shows that during the 14 years 1905-06 to 1918-19 the sum of £2,635 was distributed amongst the employees, while £1,390 was allocated to the employer. This is equal to about £188 per annum to employees and about £100 per annum to the employer. Assuming an average of 10 regular employees, the net result is that each employee would receive over £18 per annum, or about 7s. per week on the average.

Now, the result of the operation of a profit and loss sharing scheme should be to increase the total profits over a period of years—such increase being due not only to increased effort on the part of the employees but also to better organisation on the part of the employer and to the much greater confidence which it gives him in the direction of more intensive production in every way. Unfortunately, it is impossible to make any useful estimate of what this increase in profit might amount to, but it is clear that unless the employer is satisfied that there is an increase he will, rightly or wrongly, be inclined to think he is giving "something for nothing."

- (e) The question is commonly raised: In what way do the employees share in the *losses*? The table given should make it quite clear that they do share. Assuming that during the years 1909-10 to 1912-13 the employees had done their utmost, but that for reasons beyond the control of either employer or

TABLE I.—Profit and Loss Sharing Statement for the 14 Years 1905-6 to 1918-19.

Year ending	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919
Receipts during year	£ 1,886	£ 1,910	£ 2,020	£ 1,685	£ 1,739	£ 2,238	£ 1,575	£ 1,912	£ 1,773	£ 2,960	£ 2,875	£ 5,499	£ 4,064	£ 3,752
Capital—end of year	2,401	2,449	2,260	2,564	2,594	2,038	1,830	1,848	1,724	2,431	3,053	3,947	4,705	4,775
Totals	4,287	4,359	4,280	4,249	4,133	4,241	3,405	3,560	3,497	5,391	5,910	9,446	8,829	8,527
Capital—beginning of year	2,423	2,401	2,449	2,260	2,564	2,394	2,038	1,870	1,648	1,724	2,431	3,047	3,947	4,705
Payments during year	1,563	1,379	1,454	1,337	1,403	1,783	1,360	1,555	1,493	2,512	2,131	3,066	3,002	3,342
Balance	301	579	377	652	160	64	27	155	356	1,155	1,348	1,533	890	490
Totals	4,287	4,359	4,280	4,249	4,133	4,241	3,425	3,560	3,497	5,391	5,910	9,446	8,829	8,527
II. Cash Wages Paid	486	446	434	430	370	361	387	393	388	433	473	536	629	874
Add rent of Cottages (2)	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Total Employees' Wages	496	456	444	430	380	371	397	403	398	443	483	546	629	884
Proportion to ineligible Workers	30	35	30	28	33	24	18	34	36	33	48	36	40	64
" eligible Workers	466	421	414	402	347	347	379	369	362	410	435	510	589	820
III. Management Charge	160	160	160	160	160	160	160	160	160	180	200	250	300	360
Work done by two Sons	—	—	—	—	—	—	—	—	—	59	41	60	125	160
Total Employer's Wages	160	160	160	160	160	160	160	160	186	219	241	310	425	520
IV. Balance as above	301	579	377	652	160	64	27	155	356	1,155	1,348	1,533	890	420
Defect Interest plus Employer's Wages	245	244	246	238	250	244	241	234	252	305	362	507	622	698
Add Farm House Rent (£20) plus Farm Produce used in House	56	335	131	414	—	180	214	—	104	890	986	1,026	268	—
Carry to per cent. to Reserve Fund	116	395	191	474	—	120	144	—	174	920	1,066	1,106	368	—
Amount available for Distribution	104	356	172	427	—	—	—	—	—	828	960	996	331	64
Allocated to Employer	75	23	126	216	—	—	—	—	—	274	319	361	233	23
" to Employees	7	23	148	291	—	—	—	—	—	553	577	595	185	41
" to Reserve	5	20	8	20	—	—	—	—	—	41	64	42	43	—
Total Reserve Fund	17	76	103	170	140	80	8	0	41	174	344	496	546	334

NOTE.—(1) Interest charged at 3½ per cent per annum for 1905/6 to 1910/11. £80 loss £132 loss £133 loss
 " " " " 1911/12 to 1913/14. carried carried carried
 " " " " 1914/15 to 1918/19. forward, forward, forward,
 against profits.

(2) No allowance made for interest accruing on Reserve Fund or for interest payable on loans carried forward.

(3) The method here adopted of dealing with the Reserve Fund is only one of several possible methods.

employees the farm still showed losses, is it not true to say that the employees had given "something for nothing," *i.e.*, that they had shared in the losses? They had worked harder than they had any need to, and for this extra effort they had received nothing.

- (f) Lastly, it must be pointed out that the relatively high profits shown during the war years were partly due to the realisation of the capital in the soil by cross-cropping and so on. Hence, had a scheme of profit and loss sharing been in operation, the farmer would have been justified in placing a certain amount to a Special Reserve Account towards the time when this capital had to be put back into the soil.

11. Conclusion.—It is not possible nor desirable in an article such as this to go into details of the actual book-keeping entries which would be necessary to give effect to the above proposals and results. Suffice it to say that this is a comparatively simple matter, and, as already indicated, would be subject to the scrutiny of a qualified auditor. It only remains to mention that suitable steps should be taken to ascertain the views of the employees before any decisions are arrived at, either by meeting the employees as a body or, preferably, by meeting a small committee appointed by themselves. . Given confidence between "master and man," there is every reason why a scheme of profit and loss sharing should succeed; without this confidence it is almost certain to fail.

THE ALLOTMENT MOVEMENT IN ENGLAND AND WALES.

SIR DANIEL HALL, K.C.B., F.R.S., has recently delivered a series of three Chadwick Lectures at the Royal Sanitary Institute on the Nation's Food Supply, with special reference to the allotment movement. An abstract of the first lecture, entitled "Our National Food Supply: the Limits of Self Support," was published in the issue of this *Journal* for last month, p.133. The two subsequent lectures dealt with the possibilities of allotments in this country, both from the economic and the social point of view. The following is the substance of Sir Daniel Hall's remarks in his second and third lectures:—

In the second lecture Sir Daniel Hall discussed the practical working of allotments. He opened with a brief history of this branch of land cultivation, which goes back to a very early date. Statutes of the time of Henry III. seem to indicate that wherever changes in land occupation tended to make labourers landless, measures were afterwards taken to assist them to obtain control over a small portion of cultivated ground. The gross effect, however, was never great, and it is estimated that in the early years of last century less than 1,000 rural allotments existed in the county of Oxford. During the last century the movement spread steadily, stimulated for a time by the wages agitation of the 'seventies, but beneath the advancing wave of agricultural depression the effort died away. Two classes of allotments were discussed; the comparatively small allotment, really a detached garden, worked by the wage-earner in towns and villages, and the larger parcel of land by which the rural labourer has attempted to eke out his indifferent earnings. As a rule the occupier of the first class of allotment consumes all the produce, whereas the occupier of the second class aims at having some surplus to sell.

In the last return of land occupied as allotments under the Small Holdings and Allotments Act, the average size of the holdings was one-sixth of an acre, which shows that many of the allotments are on the large side. During the War, on the other hand, the 273,000 allotments created by local Authorities under the Defence of the Realm Regulations worked out at about 14 to the acre, or about 11½ rods each. The larger type enabled the labourer to feed his family during the period of lowest wages, but at a great expense of personal labour. Such allotments, although they rendered low wages possible, were no help to agriculture as a whole. For the last 80 years the labourer has been trying to better his position, and an

allotment has been his best support in the struggle. While he retains it he has always some alleviation of poverty, and his personal interest in the land can never be so small as it was in the opening years of the 19th century, when the movement may be said to have taken definite shape.

The history of small allotments is more difficult to trace, but these allotments certainly took their origin in the 19th century, at the time of the development of the industrial system and the growth of towns. Practically all were provided by private enterprise between 1830 and 1840. It was not until 1887 that public authorities obtained powers enabling them to acquire land and let it in allotments. The Small Holdings and Allotments Act of 1908 constituted the Board of Agriculture the central authority for all such allotments. The greatest extension came during the War, in 1916, after the threat of scarcity had been fully realised. While it is difficult to estimate exactly the total number of allotments in the country, the estimated figure for 1918 was 1,400,000 allotments in being. The number at present has been put as high as 1,750,000, but official returns, not yet completely tabulated, would indicate a number more closely approaching 1,000,000. The best results are shown by Buckinghamshire, Cambridge, Northampton, Oxford and Leicester, in which counties there is one allotment for every three households in the area. Of the 150,000 acres included in the return, more than 92,000 acres are still provided by private owners, and less than one-half of the land by public authorities.

Sir Daniel Hall proceeded to consider the typical allotment, that is, one of 10 rods or one-sixteenth of an acre. Such a plot can rarely provide all the potatoes and vegetables required for an ordinary small holder. Assuming that it had to provide for a family of 5 persons and that half of the area was cropped with potatoes, the quantity produced would be barely half-a-pound of potatoes per head per day, and the same amount, or rather more, of vegetables. This is, perhaps, a low estimate. On another standard of comparison it was calculated during the War that about 3 acres would provide the necessary potato and vegetable dietary of 100 soldiers per year. Such a dietary required 13 oz. of potatoes and 11 oz. of vegetables per day. On this basis, a 10-rod allotment would provide 2 soldiers with the necessary dietary, or approximately about the requirements of 2 adults and 3 children. The general experience, however, seems to show that the produce of a 10-rod allotment requires to be supplemented at various times of the year in order to meet the demands of an average family. It

would yield produce valued at about £9 in the official retail market, of which £3 must be deducted for cost of land and working generally. The plot is, however, a substantial economic contribution to a household budget, and brings about a marked decrease in the national food bill if the number of allotments is taken at approximately 1,000,000. The allotment, however, does not as a rule yield as much as it might easily be made to do, and presents a great opportunity for increased production by more intensive cultivation.

A system of cropping* worked out by the officials of the Food Production Department was described. Sir Daniel Hall next dealt with the question of fertilisers, and emphasised the importance of maintaining sufficient humus, especially on the London clay. He advocated the keeping of some small live stock upon the allotment. This is impossible on 10-rod allotments, while on town allotments, where the owner lives at a distance, live stock could not be protected. The ideal is to have enough land on which to keep a pig. Rabbits are valuable as consumers of otherwise unedible produce and as providers of food and manure. There remained the very vexed question of tenure. No adequate solution is at present possible. With building land close to our towns at its present price, it seems as if the allotment areas must continually shift on to land not yet ripe for building. It should not, however, be impossible to ensure that no large schemes of building will be sanctioned in future, unless they provide a reasonable allowance of allotment land.

In the third lecture, Sir Daniel Hall discussed certain points which, in modern conditions of life, give a peculiar value to the food grown on allotments. He touched upon the chemical composition of food, dealing with the fat and carbohydrate constituents which supply the main source of energy; the proteins which supply the waste of tissues; and the mineral salts, which are necessary to build up bone and to form part of the constituent of blood. While these constituents alone can be summed up as food, recent investigation has shown that there are other necessary elements in diet without which life cannot be maintained. The addition to essential constituents of a minute quantity of certain natural foods, such as milk, immediately makes chemically-prepared food useful to the animal, enabling it to thrive and to reproduce its kind upon the experimental diet. Of these essential elements, insignificant in amount, the action is not yet understood. They

* The scheme is explained in a Leaflet (No. 313) recently issued by the Ministry. The system of cropping was also illustrated in a chart published on p. 83 of the issue of this *Journal* for April, 1920.

may be termed the keys to the doors of the otherwise closed food stores. These substances have been called *vitamines*, but it is preferable not to speculate about them and to call them simply accessory food factors. Of these, three at least have been distinguished :—(1) the so-called fat-soluble factor, promoting growth and preventing rickets in young animals and maintaining health in adults ; (2) the anti-neuritic factor, in the absence of which disease like beri-beri occurs ; (3) the anti-scorbutic factor, that guards against scurvy.

The important feature of these *vitamines* is that although they occur more or less in certain animal foods, they are manufactured only by living plants. They have the power of keeping off " deficiency " diseases, such as rickets, imperfections of teeth and certain skin diseases. Hence one of the great values of the allotment, especially where conditions of food supply are difficult, is that it provides all classes of the community with sufficient material rich in *vitamines*. But for the allotment, these essential elements might be hard to obtain, and it is to be feared that before the War they were abnormally short in the diet of many classes of the population.

The benefits of the allotment to the community from a purely social point of view were next emphasised. The individual can never be satisfied with purely passive amusements ; he must be an active participant in the game. There is no more deeply-seated desire or delight than that which men associate with growing things, and this primitive instinct finds its highest expression in the fancier's pleasure of introducing specially beautiful or finely-developed specimens. In this he realises the joy of the creator and artist. This touch of nature was well exemplified in the early years of the 19th century by the working-men florists of the northern and midland manufacturing towns. It is unfortunate that they are dying out, for to their efforts we owe the most beautiful varieties of carnations, tulips, chrysanthemums and pansies, and also the best varieties of gooseberries.

The growing of flowers, fruits and vegetables, the quickened interest of competitions, made life very real and vivid, and lent a glimpse of poetry and nature-worship to men whose lot was otherwise cast in grey and even sordid surroundings. Similarly, the growth of the allotment movement will once again provide the majority of men with a plot of land they can call their own, and will not only put them in a sounder economic position and help to ensure the health of their families, but it will also provide an indispensable element of active and stimulating interest in life.

SOME FEEDING EXPERIMENTS WITH DRIED BLOOD.

L. F. NEWMAN, Dip. Agric. (Camb.),

School of Agriculture, Cambridge University.

VERY considerable quantities of blood are available daily in the abattoirs and slaughterhouses of Great Britain. The blood is collected in pans or allowed to drain away into a collecting gully. In some of the smaller slaughterhouses the blood is either wasted or used for manure, as only a small amount is obtained daily. In the North of England some of the public abattoirs collect blood for the production of serum and for the manufacture of "black puddings," etc.

The quantity of blood potentially available for these purposes may be estimated from the fact that about 30 lb. are obtained when a bullock is slaughtered, and during the years before the War about 3,080,000,000 lb. of meat per year was home-killed.

In recent years several firms have placed dried blood on the market as an animal food, and considerable claims have been made as to the value of this preparation when used as part of a fattening animal's rations. A certain amount of dried blood is thus available as a food for animals, and during the War the difficulty of obtaining nitrogenous foods, especially for pigs, but also for other animals, led to a number of inquiries as to its value and safety as a nitrogen-supplying form of diet. It was, therefore, considered desirable by the Food Investigation Board to institute a series of trials in which blood was the main source of nitrogen, with the object of obtaining data as to its value. The two ordinary grades of blood obtainable are (1) blood dried immediately after collection, and hence free from objectionable odours or decomposition-products; and (2) blood collected in small lots and stored before drying. The second grade is only suitable for manure, while the first is on sale as an animal food. As **fresh blood can** always be obtained at the larger abattoirs in **quantity** and dried down immediately, a constant supply is obtainable, limited only by the output from the drying plants.

Dried blood, when properly prepared, is a dry powder with little **smell**, a pleasant meaty taste, and a salt flavour, and is quite **different** from the fresh clots of blood which are sometimes

fed to pigs together with such offal as the "manifolds" or third stomachs of sheep and oxen, where proximity to a slaughterhouse allows purchase in a fresh condition.

A series of experiments was, therefore, designed to test the value of dried blood as an addition to ordinary carbohydrate diets, and also to ascertain how far it could be used to supplement the deficiency of a single foodstuff unsuitable by itself, either owing to lack of nitrogen or to absence of accessory food factors.

Feeding Trials.—A number of trials have been carried out by different investigators on dried blood, and the results have indicated that it possesses considerable food value when added to a mixed diet, but it was decided to restrict the experiment to the effect of blood as an addition to a carbohydrate diet. For this purpose two series of experiments were arranged :

- (1) Blood as an addition to maize meal.
- (2) Blood as an addition to wheat offals.

Some experiments on the addition of casein to maize meal are recorded in *Amer. Jour. Bio. Chem.* (Vol. xxix., Part 3), maize + casein + salt mixture and maize + germ being tried against maize + salt mixture only. In these trials three animals in each lot were fed for a period of 180 days, with the following results :—

Maize + casein + salt mixture :	average gain	179 lb.
Maize + germ	.. .. "	119 "
Maize + salt mixture only	.. .. "	12.3 lb.

These results indicate an extraordinarily low value for maize as a single food, and it was thought that a basal diet of maize would allow any effects of added blood to be clearly seen. It has also been stated that the addition of blood to an ordinary diet not only caused a greater increase in the live weight of blood-fed pigs than would be expected from its food value, but also that the proportion of the carcass to live weight was greater than that in animals fed in the ordinary way. It was therefore decided to follow the pigs through the slaughterhouse and to ascertain the dead-weight proportion of the animals as well as the gross increase during the course of the experiment.

Twenty-eight pigs were selected and divided into four lots of seven pigs each, each lot being arranged to average, as nearly as possible, the same total live weight. Each included two "large white," one "large black" and four cross-bred pigs, so that a fair average on such animals as are used in ordinary farming practice could be obtained.

Experiment I.—The pens of seven pigs were fed as follows :—

- Lot I. received wheat offals only.
 „ II. „ maize meal only.
 „ III. „ wheat offals and dried blood.
 „ IV. „ maize meal and dried blood.

In addition, each pig received $\frac{1}{2}$ oz. bone meal daily.

The amount of blood fed to each pig in Lots III. and IV. was 2 oz. per day to begin with, rising gradually to 6 oz. per pig per day, an average of 4 oz. per day ; an extra 5 lb. per pen was allowed so as to bring the total to 1.25 cwt. in all for both lots of blood-fed pigs. It took two or three days before the pigs tolerated the blood, but after they became used to the mixture they took it willingly, and apparently liked the taste.

The blood used was a mixture of equal parts of blood supplied by two different firms. The two samples were rather different in composition, as shown by the following analyses :—

				Percentages.	
				A	B
Water	..	..	..	7.27	8.30
Ash	..	..	..	8.60	3.63
Protein (N \times 6.25)	..	..	..	50.00	82.78

It will be seen that the samples varied considerably in composition, as A was whole blood while B was partly clot from serum production. Both, however, were well dried, free from smell, and finely divided.

Each lot of pigs received altogether 1.25 cwt. of blood during the eleven weeks of the experiment, and the corresponding pen had a weight of maize and offal added to make up an equal total weight of ration. During the last fortnight but one the pigs in Lot IV. received 28 lb. more maize than those in Lot II. and 112 lb. more during the last fortnight, as it was obvious that they were needing an extra ration. In the other cases, however, the total weights of food given were similar. Lot II. occasionally refused food, and 37 lb. of maize in all were weighed back and carried on to the next meal, when an equal amount was deducted from the weight of food fed at that meal.

During the experiment the ration was fixed by the maximum which could be fed to the control pens. In both diets the blood-fed pigs were much livelier and more hungry than the controls, and had the former been on an *ad lib.* diet they would have taken much more food than the controls.

It was originally hoped to keep the nitrogen ratio constant by substituting pure starch for some of the maize and offal in the blood-fed lots, but this was found to be impossible in practice, owing to the difficulty in obtaining starch in sufficient quantity, and it is not in accordance with farming practice

to use pure nitrogen-free starches for farm animals. The object of the experiment was to demonstrate the use or value of blood as an addition to ordinary agricultural foods.

The composition of the offals and maize used was as follows:—

	<i>Maize Meal.</i>		<i>Wheat Offal.</i>
Water	12.81	....	12.62
Ash	1.12	....	4.53
Protein (= N × 6.25)	9.37	....	14.30
Fibre .. ..	.60	....	9.60
Fats	3.26	....	4.16
Carbohydrates.. ..	72.84	....	55.99

These were supplied through the ordinary channels; the maize was of good quality, well-ground and in good condition, but the offals were of somewhat inferior quality, especially in comparison with pre-war standards. Different bags varied somewhat in appearance, so that three were kept in use at a time and the ration made up by mixing the contents to ensure as far as possible an even quality from day to day.

The pigs were weighed at weekly intervals, and after 11 weeks' feeding gave the following total results:—

<i>Lot.</i>	<i>Weight at start.</i> <i>lb.</i>	<i>Weight at finish.</i> <i>lb.</i>	<i>Gain or Loss (-).</i> <i>lb.</i>	<i>Value of Gain or Loss (-).</i>		
				<i>£</i>	<i>s.</i>	<i>d.</i>
I. ..	381½	600	218½	11	7	0
II. ..	409½	406	-3½	-0	3	0
III. ..	402½	686	283½	14	18	0
IV. ..	415½	623	207½	10	18	0

The pigs in Lot II. showed very little appetite, and after a week or two took their ration of plain maize meal only with reluctance and when pressed by hunger. As will be seen from the table, they put on no weight and rather fell off in condition, so that it was not considered advisable to continue the diet. Lots I. and III. were continued on their diet until they weighed about 1 cwt. (porker), so that it would be ascertained whether the use of blood gave a greater proportion of carcass to live weight than wheat offals only.

<i>Lot.</i>	<i>No.</i>	<i>Live weight.</i>	<i>Carcass weight.</i>	<i>Plucks.</i>	<i>Entrails.</i>
		<i>lb.</i>	<i>lb.</i>	<i>lb.</i>	<i>lb.</i>
I.—(i)	..	120	80	4	17
I.—(ii.)	..	136½	88	6	14
I.—(iii.)	..	120½	81	5	14
I.—(iv.)	..	120	84	4	12
III.—(i.)	..	131	85	6	18
III.—(ii.)	..	138	93	6	15½
III.—(iii.)	..	115	78	4	14
III.—(iv.)	..	108	71	4	16
III.—(vii.)	..	119	94	5	13
IV.—(i.)	..	125½	88	4	13
IV.—(v.)	..	121	83	4	11
IV.—(vi.)	..	124	79	5	14

Experiment II.—It was then thought that the addition of a small amount of fresh vegetable food, such as is often given to pigs on farms, might possibly affect the general metabolism of the animals. The pigs in Lot II. were divided into two pens, and one pen received a single kohlrabi plant per pig per day, in addition to the diet, for another period of four weeks. The results are shown in the following table. The same procedure was adopted with the pigs in Lots I., III and IV., where two of the pigs not intended for slaughter were given kohlrabi and tried against two on a continuation of the experimental diet.

	Weight at start. lb.	Weight at finish. lb.	Gain or loss (-). lb.
<i>Lot. I.</i>			
A. no kohlrabi	153	199	46
B. kohlrabi ..	156½	212½	56
<i>Lot II.</i>			
A. no kohlrabi	173½	160	-13½
B. kohlrabi ..	176½	191	14½
<i>Lot. III.</i>			
A. no kohlrabi	185	240	55
B. kohlrabi ..	186½	238	51½
<i>Lot. IV.</i>			
A. no kohlrabi	134½	105½	1
B. kohlrabi ..	115	153½	35

The experiment was then discontinued. The kohlrabi-fed pigs in Lot II., receiving maize meal, improved considerably in health, became lively, and took their food with much greater relish. The control pigs on maize meal alone still refused their food and made a slight loss in weight.

In Lot IV. the pigs receiving no kohlrabi did not increase in weight, but were quite lively and in fair general condition. The seventh pig in Lot II. was taken out of the second part of the experiment as he had injured his leg against the feeding-trough. He was placed by himself and given an *ad lib.* ration of fresh mangolds in addition to maize. In three weeks he had doubled his weight from 35½ lb. to 84 lb. During the period of feeding with kohlrabi the maize-fed pigs were given an *ad lib.* diet, but they did not take more than they had done during the course of the first experiment.

Conclusions.—The results obtained indicate that the addition of blood to an ordinary farm ration of wheat offals may cause a very considerable gain in weight compared with the results obtained from a farm diet of offals only, while the addition of blood to plain maize meal may give an increase equal to the results obtained from feeding offals only. The results obtained

on maize meal alone compare exactly with those obtained by the American observers who undertook the experimental work of feeding maize to pigs as a comparison with maize + casein.

The addition of a small quantity of fresh vegetables to the diet showed a very considerable gain against an ordinary ration, but their use appeared to be unnecessary when a full diet of wheat offal plus blood was fed. It is, however, recognised that this part of the experiment is tentative only and requires a further trial with at least seven pigs in each lot before any definite conclusions can be arrived at.

The results are recorded, as the pigs were in such a suitable condition (*i.e.*, used to the diet) after 11 weeks of experiment as to justify the trial even on two or three animals.

The cost of dried blood is fairly high, but it must be remembered that only a few oz. should be fed daily, or an excess of nitrogen in the diet would result, and this is undesirable. In these trials the total cost of the blood was as follows:—

1.25 cwt. blood per *pen* at 18s. 6d. per cwt. = 23s. 1d. per *pen* for Expt. I.

20 lb. blood per *pig* at 18s. 6d. per cwt. = 3s. 4d. per *pig* for Expt. I.

The thanks of the writer are due to the Food Investigation Board, who provided the costs of the experiment, and to Professor T. B. Wood and Professor Hopkins of the Animal Nutrition Institute, Cambridge University, for permission to use their laboratories and Nutrition Station and also for much assistance and advice.

THE STUDY OF RURAL ECONOMY AT OXFORD.

S. L. BENSUSAN.

SOME time in the days when the star of the first Napoleon was in the ascendant, and nearly ten years before Great Britain, by her victory in Trafalgar Bay, assumed the hegemony of the seas, Professor Sibthorp founded in Oxford and endowed a Professorship of Rural Economy. Through the century that followed the study languished in the absence of urgent need, but when Time gave birth to conditions that demanded change, the means of bringing it about were to hand. The outstanding question would appear to have been one of detail rather than of principle, for when the authorities at Oxford decided to interest themselves anew in agricultural work, they were faced by several difficulties.

In the first place, Cambridge had already taken up the purely scientific side of agriculture and was engaged on successful work of national importance. The study of agriculture on modern lines was the keynote of the work at University Colleges like Wye and Reading, and it might have seemed at first that, without duplicating either the research of Cambridge or the technology of the leading farm-schools, it was well-nigh impossible to find a field for service. Fortunately, Oxford surveyed the outlook "with a dilated eye." It was seen that while much work of great importance was in progress elsewhere for the benefit of men of science and those who proposed to follow high farming, nothing was being done deliberately, and in pursuit of a well-considered programme, for those land-owners who have for centuries been the upholders not only of agriculture, but of a great rural tradition, men whose sons, generation after generation, find their way to the University.

At a Conference held in 1916, and attended by Lord Selborne, Lord Ernle, the Master of Balliol, Sir Daniel Hall, and others, a scheme was devised to give the future landlords of Britain a training, practical and theoretical, that will do more than merely fit them to take intelligent oversight of their tenants' acts of husbandry. It will enable them, if they are prepared to shoulder the heavy burden of their responsibilities, to turn their home farm into a model farm for the district; a holding on

which the latest methods, the newest machinery, and the most efficient management may be studied by all who are concerned to make the best of their opportunities. This does not exhaust present needs. The questions before the landlord to-day are many and varied. Quite apart from farming on the best lines, he must understand organisation, costs, transport, rating reform and co-operation. The history of English land and of English landlords, and the curious complicated story of Local Government, are also matters that should concern him, and he must learn, too, to discover the most profitable farm unit for his estate, whether it is the small holding up to 50 acres, the large farm of over 500, or whether some special circumstances make it possible for him to tread in comparative safety the ground that lies between.

The *Schola Oeconomiae Rusticae* is firmly established to-day in Parks Road, Oxford, on land belonging to St. John's College, which shares with Balliol the honour of having given wise and generous support to the new movement. The Institute for Research in Agricultural Economics, of which Mr. C. S. Orwin is Director, is housed in the same building, which was completed in 1914, and is adequately equipped for the work in hand. The present Sibthorpe Professor and Head of the School is Dr. Wm. Somerville, of St. John's, the eminent agriculturist whose experiments at Poverty Bottom Farm in Sussex went far to prove that there need be no such thing as infertile soil in England. His later work on the renovation of our 15 million acres of English and Welsh pastures, most of which stand so sorely in need of repair, is too well known to need comment. The Lecturer on Agricultural Chemistry, Mr. C. G. T. Morison, of Balliol, is responsible, with Mr. Orwin, for much of the administrative work in connection with the school because at the present time the Colleges, with the single exception of University College, have no tutors in Rural Economy, and this lack, which it would be hard to remedy just now, has imposed upon a small band of devoted teachers a very extensive round of work for which time must be found when the duties of a normal day have been accomplished.

In connection with the School of Rural Economy, the Temple Farm at Sandford, about three miles south of the city, provides for all practical demonstration. The farm with its old Tudor house and pleasant avenues has more than purely agricultural associations. It was a home of the Knights Templars, and Sandford holds still its faint but pleasant memory of Mathew Arnold, one of Oxford's most loyal sons in the mid-Victorian

time.* Temple Farm is the property of Magdalen College, and consists of about 120 acres of arable, including some that looks to be heavy and unpromising, and upwards of 200 acres of grass, of which about one hundred are kept for hay. There is a dairy herd of about 25 Shorthorn cows, for which it is claimed that they are among the most productive on the books of the Oxfordshire Milk Recording Society, and practical demonstrations are in the good hands of Colonel W. R. Peel, M.A., D.S.O. Those who follow Colonel Peel's sound and attractive lectures are safe, *experto crede*, to have their attention directed to all the salient points of practical farming. The farm accounts are strictly kept. They are analysed, and income and expenditure are apportioned to their proper departments. The farm enjoys a special advantage from the proximity of the Oxford Steam Plough Company, of which the depot is only a mile away.

Perhaps it is a little late in this paper to point out that the University of Oxford now gives a degree in agriculture, the B.A., which may be taken "with distinction." The student must keep his nine terms and join a College or the Non-collegiate body. He must pass Responsions and follow the regular course of examination towards a degree, but begins his study of Agriculture from the day he enters into residence. It is unnecessary to deal here with these examinations further than to point out that those who succeed in satisfying the examiners will have a competent knowledge of the economics and history of agricultural production, distribution, organisation, farm and estate management, and agricultural law, while they may add to it elementary physics, chemistry, zoology and botany. To meet all fees and to maintain himself at Oxford it is estimated that the present cost to a student is about £250 a year.

This effort to bring agricultural education into line with the general tutorial system of Oxford, this grant of a degree in agriculture which, it is well to remember, is the highest of its kind in England, shows that Oxford, for all its aloofness from the stress and turmoil of normal times, is in close touch with the needs that these times have brought to birth. Some of us may, perhaps, be pardoned for believing that this stone which the builders have so long rejected may become, if not the headstone of the corner, at least one of the really essential supports of the greatest educational institution our civilisation has yet evolved. The organisers of the movement are no mere dreamers. Their

* "I know what white, what purple fritillaries
The grassy harvest of the meadow fields
Above by Ensham, down by Sandford, yields,
And what sedged brooks are Thames's tributaries."

vision of a regenerated England is no baseless fabric. Dr. Somerville, while admitting the immense possibilities of the School, which he has done so much to establish, deals steadily with hard facts. There are 26,000,000 acres of cultivated or cultivable land in England and Wales, and he holds that a 20 per cent. improvement is possible. On much of the grass land he looks to see a double quantity and a double quality of production, so that where two sheep are grazing to-day, four sheep may graze in seasons to come, each doing twice as well as its predecessors. Dr. Somerville is taking nothing for granted, and many old theories of production are being put to a searching test. For example, he finds that on some soils for which lime is recommended as a cure for sourness, lime alone does not pay, and that a phosphatic manure must be added. The spirit of inquiry, and the infinite possibilities that may follow wise experiment, may, perhaps, account in part for the fact that in the School of Agriculture and the Forestry School there are now upwards of 200 students, including five women, and there are few, if any, Colleges in Oxford at which it is not possible to find some students who hope to take their degree in agriculture.

The Institute for Research in Agricultural Economics was established by the Development Commission through the Ministry of Agriculture, and in spite of the extraordinary difficulties that beset the keeping of farm-accounts, particularly when an effort is being made to establish costs of cultivation, Mr. Orwin can make out a very strong case for work on certain definite lines. The Institute has already conducted inquiries into costs of production, the agriculture of three counties (Oxfordshire, Berks and Northants), the economic aspects of small holdings and allotments, the expenditure on labour per acre, and transport problems. It will never be possible to state costs of production in terms of England and Wales, or in terms even of a great part of either without doing injustice to the majority of those concerned, because these costs naturally vary in accordance with the nature of the soil, the method of cultivation, the competence or incompetence of the farmer, the state of the weather, the difficulties of transport, the cost of feeding stuffs and artificial manures, and a host of other questions that must occur to any man who has ever looked, even to a few fields, for a return on his outlay and endeavour. The question of the production that is best for a district is, however, one that belongs to economics.

It is possible to establish definitely the production per man and per acre in any given area, and, eliminating the human

factor, to draw really valuable conclusions as to the type of management and size of holding that will pay best in a district that has been carefully surveyed. Cost accounts are individual affairs, but they enable the farmer to learn what his holding costs him in food, labour, management, transport and the rest. Costing enables him to select the crops that will pay and the stock that is worth keeping, and to leave the others alone, and while deciding where it is better to grow the material for production, such as hay and roots, for example, to sell it to those who will provide the finished article in the form of beef and milk. Clearly the cheapest source is the proper source, and the School of Rural Economy is in a position to decide beyond all possibility of doubt the question of cheapness. It can bring large things and small into the region of proof, and a striking example of the latter class is provided by the question of overtime. Certain farmers think it does not pay to give overtime, but those who have been in touch with the School of Rural Economy at Oxford know better, for it has been pointed out to them that when their workers go home because the farmer will not pay overtime, he must support his horses in idleness, at a cost (net loss) which might be converted into a profit if he considered the question of overtime in all its bearings.

It may be suggested that the new School of Agriculture at Oxford, youngest and not least vigorous branch of that venerable Tree of Knowledge, is designed, despite its particular purpose, to serve all classes of the agricultural community, from the owner of many acres down to the actual tiller of the soil. Farm costings, from which some of us, with the best intention in the world, cannot help shrinking, are of more than passing value, because by their aid the farmer will be able to decide within a little the return that agricultural produce in this country is capable of making. On this solid basis it will be possible, beyond the shadow of a peradventure, to decide what wages a rural industry can pay and what difference in its capacity to pay will follow from enlightened methods, to the fruition of which landlord, farmer and farm labourer, have given their best, united endeavour.

THE COMPOSITION AND FEEDING VALUE OF SILAGE.

THE steady extension of the practice of ensilage in this country in recent years has made it desirable that the meagre information hitherto available as to the composition and feeding value of silage should be supplemented as far as possible. The older analyses can hardly serve as a reliable guide to present-day practice, in view of the greater variety of crops and the improved methods of preparation now used.

With a view to initiating the collection of reliable data arrangements were made by the Food Production Department in 1918 for obtaining from various sources samples of silage made in 1918-19. The analysis of 17 samples was kindly undertaken by Mr. Gwilym Williams, of the School of Agriculture, Cambridge, and his results are summarised on p. 280. Estimates of the relative feeding values are also given, these estimates being based upon the composition and digestibility of the materials.

Moisture.—Attention may be directed first to the fact that there was great variation in the proportion of moisture in the 17 samples (ranging from 58·4 per cent. to 81·62 per cent.); and conversely to the percentage of dry matter (ranging from 41·6 to 18·38 per cent.). The highest percentage of moisture (81·62) is accounted for by the fact that this sample was a maize silage, the thick, fleshy stems and leaves of this crop inevitably carrying a large proportion of water into the silo. The three driest samples were all from one farm, and it would seem that either the crop was allowed to ripen to an appreciable extent before cutting, or was dried somewhat before transferring to the silo.

Apart from these four samples the percentages of moisture are distributed fairly uniformly between the limits of 67 per cent. and 78 per cent., which may, perhaps, be regarded as the normal range of variation, with an average in round figures of 73 per cent. moisture, or 27 per cent. dry matter.

Albuminoids or Proteins.—The albuminoids (or protein) of feeding stuffs always possess a special importance, since they have certain bodily functions to sustain which no other ingredient can support.

In some analyses a distinction was made between "crude albuminoids" (or crude protein) and pure albuminoids (or pure protein). The former represents the total nitrogenous

matter of the silage, while the latter indicates how much of this is real albuminoid material. The difference (commonly referred to as "amides") represents nitrogenous ingredients which, though not without value to the animal, do not possess the full virtue of the true albuminoids. These "amides" are always present to some extent in the greenstuff as it goes into the silo, but the fermentation processes which take place there tend to increase the proportion of "amides" at the expense of the true albuminoids. Consequently, so far as the feeding efficiency of its nitrogenous matter is concerned, the silage is somewhat inferior to the green fodder from which it is made. In the nine cases where the separate determinations were made the pure albuminoids formed from 50 per cent. to 81 per cent. of the crude albuminoids.

The point is probably not of serious practical consequence, however, since the silage will commonly be fed as part of a mixed diet, the other ingredients of which can be made to ensure an adequate supply of albuminoids.

Carbohydrates and Fibre.—The feeding value of silage in a mixed diet will be chiefly determined by its content of digestible carbohydrates and fibre. The loss due to fermentation in the making of silage falls more heavily upon the carbohydrates than the fibre, so that the proportion of the former is somewhat lower than in the original green fodder. The proportion of fibre is consequently increased, but it is probably rendered more digestible by the fermentative action. With the exception of a *Trifolium* silage, the proportion of carbohydrates was appreciably higher than that of fibre.

Relative Feeding Value of Silage.—In order to obtain an estimate of the feeding values of the various silage preparations as compared with each other and with roots and hay, respectively, the "starch equivalent" method of assessment was used. For the purposes of this method it is necessary to know not only the composition, but also the digestibility of each material. In the case of these silage samples, however, there was no information as to their actual digestibilities, and, consequently, it has been necessary to assume the same digestibility for each, this being taken as the average digestibility of oat and vetch silage given in published tables of digestion co-efficients. As there was no means of knowing how far this assumption may have been valid, the estimates of feeding value arrived at can only be regarded as rough approximations.

The feeding values were expressed as "maintenance starch equivalents," the figures representing the number of pounds

of starch which, in a mixed diet containing an adequate supply of albuminoids, would have the same value for simple "maintenance" purposes as 100 lb. of the silage. Taking these figures as the basis, and the corresponding "maintenance starch equivalents" for roots and hay of average quality, the data given in the last two columns of the table are arrived at.

In this connection it may be pointed out that although silage in farm economy and feeding practice serves commonly as a substitute for root crops, its only outstanding resemblance to roots in feeding properties is its succulence. It is more fibrous and less digestible than roots, and in chemical composition, apart from its high moisture-content, resembles the hay that might alternatively have been made from the original green fodder.

The estimated "starch equivalents" range from 10.3 per cent. for the maize silage to 23.3 per cent. in the case of a lucerne and seeds second-crop silage. The value in terms of roots ranges from 1.12 to 2.54 tons of roots per ton of silage, while in terms of hay the range is from 2.1 to 4.76 tons of silage equal to 1 ton of good hay.

The wide range of variation thus indicated is due more to the great differences in moisture-content of the silages than to intrinsic differences in the feeding value of the actual nutritive matter. If the silages are reduced to a comparable basis of 70 per cent. of moisture (or 30 per cent. of dry matter) the range of variation in starch-equivalent is only from 15.5 per cent. to 17.8 per cent.; that is, the best is only about 15 per cent. better than the worst. In view of the assumptions underlying these estimates it will be safest to conclude that, so far as chemical analysis can furnish guidance, the various silages had substantially the same feeding value apart from the variations in moisture-content. This conclusion only holds good if the silage is fed in a mixed diet which supplies sufficient albuminoids for the needs of the animal. If the albuminoid supply were scanty the silages containing the higher proportions of albuminoids would have a higher intrinsic value than they are credited with in the above estimates.

Assuming 30 per cent. of dry matter, the average "starch-equivalent" for the 17 samples is 17.05 per cent. One ton of such average silage would be equivalent for "maintenance" purposes to 1.85 tons of roots; or 2.87 tons of silage would be equivalent to 1 ton of good meadow hay. These figures bear out closely the opinion expressed by Mr. Arthur Amos

Analyses of Silage carried out at Cambridge for the Food Production Department in 1919

No.	Nature of Sample	Water.	Fat (Ether Extract).	Crude Albuminoids (Or Crude Protein).	Carbo- ^a hydrates.	Fibre.	Ash.	Pure Albuminoids (Or Pure Protein).	Maintenance Starch Equivalent.	Tons Roots Equivalent to 1 Ton Silage for Maintenance.	Tons Silage Equivalent to 1 Ton Good Meadow Hay for Maintenance.
		Per cent	Per cent	Per cent.	Per cent	Per cent.	Per cent	Per cent	Per cent.	Tons.	Tons.
1	Grass, Tares and small quantity of Oats	60.17	1.20	5.01	18.82	11.06	3.74	3.24	22.8	2.48	2.15
2	Tares and Oats	62.27	.98	4.48	17.90	11.59	3.08	2.93	21.7	2.36	2.26
3	Lucerne and Seeds and Crop	58.10	2.11	6.02	15.20	13.50	4.77	4.41	23.3	2.54	2.70
4	Tares, Wheat and Oats	71.00	2.17	4.12	11.77	8.72	2.22	2.48	17.2	1.87	2.85
5	Clover	67.37	1.01	4.95	12.62	9.45	4.70	3.92	17.9	1.94	2.75
6	Maize	81.62	1.37	3.25	6.91	4.48	2.35	1.79	10.3	1.12	4.76
7	Trifolium	70.13	2.33	3.92	10.28	10.96	2.18	2.41	17.5	1.90	2.80
8	Tare, Oats, Rye and Marsh Grass	74.20	2.07	3.63	10.34	8.27	2.42	1.52	14.9	1.62	3.29
9	Oats and Tares	72.30	2.47	3.53	11.39	8.02	2.10	1.80	16.4	1.78	2.99
10	Clover	74.53	.97	3.53	8.93	7.93	4.08	1.80	13.15	1.43	3.72
11	Grass	78.50	1.51	2.91	8.93	5.93	2.43	—	12.4	1.35	3.95
12	Tares, Oats, Rye, Beans and grown together	72.13	1.26	3.27	12.89	8.21	2.24	—	16.3	1.77	3.01
13	Trifolium	74.70	1.32	3.73	8.99	9.05	2.21	—	14.2	1.54	3.46
14	"	72.70	1.25	3.80	10.16	10.34	1.75	—	15.55	1.69	3.13
15	" (2nd Sample)	70.23	1.19	3.16	11.34	10.45	2.90	—	16.45	1.79	2.98
16	Rye, Oats and Tares	77.80	.67	2.72	8.86	8.69	2.26	—	12.6	1.37	3.69
17	Clover	73.50	2.45	3.24	10.71	7.67	2.43	—	15.75	1.71	3.11
									Average...	1.78	3.13

in his recent address to the Farmers' Club.* "Taking into account the chemical analyses and the feeding experiments I am of opinion that 3 lb. of oat and tare 30-per-cent. silage may be regarded as having a value slightly greater than 1 lb. of good oat and tare or clover hay, and that 1 lb. of oat and tare 30-per-cent. silage is equal to slightly less than 2 lb. of roots"

In conclusion, it must be borne in mind that chemical composition, although the most important, is not the only factor determining the nutritive value of feeding-stuffs. The physical condition, palatability, etc., must also be taken into account; these factors will doubtless in actual practice have given rise to greater differences in the values of the respective silages than are indicated by the above estimates.

† Contributed to the *Journal of the Farmers' Club* in 1920.

POTATO SPRAYING TRIALS IN THE CAMBRIDGESHIRE FENS, 1919.

F. R. PETHERBRIDGE, M.A.,

School of Agriculture, Cambridge.

THE experiments dealt with in this article are a continuation of those started in 1918, an account of which appeared in this *Journal* for January, 1919.

They were carried out on two fields lent by Mr. F. Hiam (Putney Hill Farm, Prickwillow), who bore the cost of the labour connected with the experiments.

The work for the year was planned to form part of the trials on the effect of spraying over a series of years, and also to find out if machines applying over 200 gal. per acre are likely to be more profitable than those at present on the market which apply about 100 gal. per acre.

The season of 1919 was an exceptional one from the point of view of potato blight. There can seldom have been a season in which blight did less damage. The fact that Up-to-Dates, planted in April on a gravel soil near Cambridge, were dug in October free from blight will serve to show that this disease had practically no effect on the yield of late varieties in this district.

Blight was first found at Prickwillow in a field of Eclipse on July 28th, and here it spread slowly until the lifting was finished on August 10th. On the experimental plots "blight" was found both on the Majestic and Evergoods on August 1st, but throughout the season it spread slowly, so that it was not possible until the middle of September to find more than a slight trace of it on the haulm. Growers would have regarded these plots as free from blight until the middle of September.

The Spraying.—The mixtures used were as follows:—

(1) *One per cent. Bordeaux Mixture.*—This was made in a 40-gal. tub. In the tub 4 lb. of copper sulphate were dissolved in about 30 gal. of water. As Buxton lime was not obtainable, ordinary builder's quick-lime was used: 2 to 2½ lb. of Buxton lime is usually sufficient for 4 lb. of copper sulphate, but more than this quantity of the builder's lime was used. It was slaked in a large bucket, and then made into a milky solution by the addition of water, and after settling was poured through a sieve covered with coarse sacking into the copper sulphate solution. The mixture was then well stirred and lime water added until no brown colour resulted with the potassium ferrocyanide test. Water was then added to make up the 40 gal.

(2) *Two per cent. Bordeaux Mixture.*—This was made by using double the above amounts of copper sulphate and lime.

(3) *One per cent. Burgundy Mixture.*—This was also made in 40 gal. tubs, 4 lb. of copper sulphate being dissolved in about 30 gal. of water; 5 lb. of washing soda were then dissolved in about 5 gal. of water and poured into the copper sulphate solution. The mixture was well stirred and water was then added to make up the 40 gal., when the mixture was again stirred. Every tub was tested with red litmus, which turned blue.

(4) *Bordeaux Powder*, bought ready made.

The ordinary spraying machine was of the "cart" type, the tank being formed by the bottom, sides and top of the cart. This machine did 5 rows at once, and at full pressure applied 85 gal. per acre from 3 nozzles per row. A new machine of the barrel type was tested, with a large pump and 5 nozzles per row (25 nozzles altogether), the extra pair of nozzles being 10 in. above the ordinary pair. This machine had a barrel capacity of 120 gal., and applied 200 gal. per acre.

The working of the 5-nozzle machine, with its larger pump, is much harder for the horse, and also has the disadvantage that it has to be filled at each end of the field when the field is over 15 chains long. The cart type of machine is much easier to fill by hand than the barrel type, as the liquid has only to be lifted about 4 ft.

The Bordeaux Powder was applied by means of a "Herrod's Dry Sprayer."

Harvesting.—The potatoes were lifted by means of a spinner, and the produce from each plot was clamped separately.

Field 1.—This field was the same as Field 2 in the previous year's experiments. Its history is as follows:—

1915	..	Potatoes	..	..	10 cwt. superphosphate.
1916	..	Onions	..	..	3 " "
1917	..	Onions	..	..	3 " "
1918	..	Potatoes	..	..	10 " "
1919	..	Potatoes	..	..	20 loads of farmyard manure and 10 cwt. superphosphate.

The variety of potato grown was Evergood (from Scotland), and planting took place early in April. Each plot consisted of 9 rows, 28 in. apart, and was nearly $\frac{3}{4}$ of an acre in area. The potatoes were lifted from 22nd October to 29th October, and were sorted and weighed in January.

At the time of the first spraying the weather was hot and dry, but during the previous week light rain fell on 4 days. The haulms of the potatoes were suffering from a moderate attack of aphids, which got gradually worse during the hot weather which followed the spraying. A few days after the

spraying Plots 9, 10, and 11 showed a fair amount of scorching, and the other sprayed plots showed slight scorching. At this stage the unsprayed plots looked the best.

The second spraying badly injured the haulm of Plot 10, and the damage done was obviously very serious. There was also a moderate amount of scorching on plots 4, 5, and 6. Although a trace of blight was present throughout the season, it did very little damage.

The unsprayed plots continued to look the best throughout the season, and it seemed probable that the spraying had lowered the yield on all the sprayed plots. The following table shows this to have been the case.

Plot.	No. of Spray- ings.	How sprayed	Yield per Acre.			
			Ware.	Seed.	Blights.*	Total.
			Tons. cwt.	Cwt.	Cwt.	Tons. cwt.
1	1	Bordeaux mixture, 1 per cent., 85 gal. per acre, 25th July ..	9 17.1	10	11.4	10 18.5
2	1	Bordeaux mixture, 1 per cent., 200 gal. per acre, 25th July..	8 17.1	8 5	11.4	9 17 †
3	—	—	10 17 1	7 1	10	11 14.2
4	2	Bordeaux mixture, 1 per cent., 200 gal. per acre, 25th July and 15th August ..	9 8 5	11.4	10	10 9.9
5	2	Bordeaux mixture, 1 per cent., 85 gal. per acre, 25th July and 15th August ..	9 11.4	11.4	10	10 12.8
6	2	Bordeaux mixture, 2 per cent., 85 gal per acre, 25th July and 15th August ..	9 11.4	11.4	10	10 12.8
7	1	Bordeaux mixture, 2 per cent., 200 gal. per acre, 26th July..	9 10	12.9	7.1	10 10
8	—	—	10 15.7	11.4	10	11 17.1
9	1	Burgundy mixture, 1 per cent., 200 gal. per acre, 26th July..	8 18.5	8.5	5 7	9 12.7
10	2	Burgundy mixture, 1 per cent., 200 gal. per acre, 26th July and 15th August ..	8 13	14.3	7.1	9 14.4
11	1	Bordeaux Powder, 26th July	8 18.5	14.3	5.7	9 18.5

* Blights included any potatoes not fit for ware or seed; only a small percentage of these were affected by *Phytophthora*.

† Probably a mistake in the weighings.

It was estimated that the yield of Plot 2 was equal to that of Plots 4 and 7, so that it seems probable that there was a mistake

in the weighings of this plot. Neglecting this plot, spraying with 1 per cent. Bordeaux mixture once at the rate of 85 gal. per acre (Plot 1) reduced the yield by over 16 cwt. per acre, and spraying twice (Plot 5) with Bordeaux mixture at the rate of 200 gal. per acre has reduced the yield rather more. Spraying with Burgundy mixture at the rate of 200 gal. per acre caused very bad scorching, and reduced the yield by over 2 tons per acre, while dry spraying reduced the yield nearly as much as the Burgundy mixture. (In the case of Evergoods in neighbouring fields, spraying with a patent Burgundy mixture containing copper sulphate and sodium carbonate, in the proportion of 4 parts of crystalline copper sulphate to 4.68 parts of crystalline washing soda also caused bad scorching.)

Field 2.—The history of this field is as follows :—

1915	..	Potatoes	..	..	10 cwt. superphosphate.
1916	..	Potatoes	..	..	10 " "
1917	..	Onions	..	..	2 " "
1918	..	Onions	..	..	2 " "
1919	..	Potatoes	..	..	10 " "

The variety of potato was Majestic (from Scotland). Each plot consisted of 9 rows, 28 in. apart, and was about $\frac{1}{2}$ an acre in area. The potatoes were lifted on 16th–18th October in dry weather, and each plot was weighed and clamped separately. There were few blights, and only a very small proportion of seed. The yields per acre are shown below :—

Plot.	No. of Sprayings.	How sprayed.	Total Yield per Acre.	
			Tons.	cwt.
1	—	—	12	2
2	1	Bordeaux mixture, 1 per cent.; 28th July	11	16
3	2	Bordeaux mixture, 1 per cent.; 28th July and 16th August	11	10
4	—	—	13	4
5	2	Burgundy mixture, 1 per cent.; 28th July and 16th August	11	10
6	1	Burgundy mixture, 1 per cent.; 28th July	12	12
7	1	Bordeaux mixture, 1 per cent.; 16th August	13	8
8	—	—	13	16

At the time of the second spraying the weather was duller than when the Evergoods were sprayed. The aphid attack was not nearly so bad as on the Evergoods, and the scorching was much less pronounced. Very little scorching was noticeable with the Bordeaux mixture, but both sprayings with the Burgundy mixture caused scorching.

Blight was present on all the plots before the second spraying, and was much more prevalent on this variety than on the Evergoods. It spread very slowly until the second week in September. Just after the middle of September the unsprayed plots were killed off by blight, whereas the sprayed plots did not die off for some time. On September 18th the percentage of green in the tops was roughly as follows :—

<i>Per cent.</i>				<i>Per cent.</i>			
Plot 1 .	..	..	2	Plot 5 .	..	..	20
„ 2 .	..	..	20	„ 6 .	..	..	10
„ 3 .	..	..	50	„ 7 .	..	..	50
„ 4 .	..	..	2	„ 8 .	..	..	2

Up to that date Plot 5 looked the worst, owing to scorching. Taking the season throughout, Plot 7 looked the best plot.

The above table shows that there was a big variation in the yields of the unsprayed plots. At the time of spraying it was noticeable that the end of the field where the plots started was not so good as where they ended, and as a consequence three control plots were left.

Spraying early with Bordeaux mixture made little difference to the yield as compared with the nearest unsprayed plot. Plot 7 was estimated before weighing to be the highest yielding plot, as there was practically no scorching, and the tops lived longer than Plot 8, which actually gave a higher yield.

It is not possible, however, to account for the low yield of the plot twice sprayed with Bordeaux, as there was little scorching on this plot, and it was expected that its yield would be only slightly lower than that of Plot 4. Plot 5 was expected to give the lowest yield, as the scorching reduced the leaf area.

Conclusion.—The above figures suggest that it is unsafe to spray potatoes in the Fens in a season like 1919. Many growers throughout the Fens scorched the tops by spraying.

After a period of hot, dry weather the leaves of potatoes are liable to attacks of green fly (aphis), and under the same conditions are liable to scorch when sprayed. It has been suggested that the scorching is due to the entrance of the spray into the punctures caused by these insects. Until this question is settled by experiments, growers are warned that by spraying in hot, dry weather, when the foliage is attacked by green fly, they risk a loss of crop through scorching.

POTATO LEAF-CURL.

A LARGE amount of careful research work has been carried out during the past few years on Potato Leaf-curl, especially in Holland, but also in Canada, Berinuda and the United States. The results obtained, particularly with regard to the early phases and possibly infectious nature of the disease, are of importance to all potato growers, and especially to those who grow for seed. Though the last edition of the leaflet on Potato Leaf-curl (No. 164) was only issued by the Ministry in 1918, it has been re-written in order that the new results may be incorporated, and in view of the importance of the subject the information it contains should be widely known. The following is the text of the revised leaflet :—

Probably no disease is more responsible than leaf-curl for the weakly potato plants and light crops so often seen, especially in gardens and allotments. In the lighter soils in the southern and drier parts of the country it is very prevalent, and is particularly abundant where the practice of using home-saved seed is followed. There is no doubt that, if its presence were eliminated, an increased yield of several tons per acre would be obtained.

The term "curl" as applied to a malady of the potato has been in use in England for more than two centuries, but it is clear that the older writers included under this name more than one disease. In the present article the name leaf-curl is applied to the disease now generally associated with the deterioration in yield of potatoes, particularly when grown in southern districts, to account for which no fungus parasite has been discovered. It is applied to that form of disease which on the Continent (where it is often very severe) has been called leaf-roll. The designation leaf-roll has also been used occasionally in this country, and is at present used in America. But as the name leaf-curl is well established throughout Britain, and is of long standing, there appears to be no necessity for changing it.

Description of Affected Plants.—The most marked symptom of potato leaf-curl is the curling or rolling inwards of the margins of the leaves (*see* Fig. 1). In mild attacks this rolling is confined to the lower leaves. The curled leaves are thicker and more crisp than in normal plants and give almost a rattle when knocked together. They are usually pale in colour and often die prematurely from the tips backwards. In bad cases the middle and upper leaves are also curled (*see* Fig. 2) and in certain varieties such as President, Midlothian Early and Lochar the whole plant is dwarfed.

The curling of the lower leaves, a feature which has been largely overlooked in the past, is a very important one by which to identify the disease, as it serves to distinguish it from other maladies such as Blackleg and Verticillium Wilt, where the upper leaves only exhibit this tendency.

Leaf-curl is perpetuated by means of the "seed." Its normal course in the southern and drier counties, where it is abundant, is as follows. During the first season that the attack manifests itself (*i.e.*, usually the second year's crop in the south) the lower leaves in a certain number of plants show curl, and there is a reduction in yield in these plants of about 25 per cent. If tubers from such plants are saved and planted the following season, more serious curling will be evident and a further and very serious reduction in yield will occur, most of the tubers being merely of seed size. If these tubers are planted, growth is often a complete failure and the crop almost nil. *The importance, therefore, especially to seed-potato growers, of recognising the disease in its early stages (i.e., during the first year when the lower leaves only are curled) and of rejecting all such plants for seed purposes, is obvious.* Other features of leaf-curl are the failure of the parent "set" to decay, and the tendency for the new tubers formed by an affected plant to cluster round the bases of the stems.

Cause of Leaf-curl.—Though leaf-curl was formerly regarded as being due to a parasitic fungus, it is now known that this is not the case; and by plant pathologists it is generally assigned to the group of so-called "deterioration diseases," its actual cause still being obscure. The symptoms manifested, such as stunting of the growth, curling of the leaves and poorness of crop, clearly indicate that the functions of the plant are not proceeding normally. One important fact has been determined, namely, that much of the food manufactured by the leaves of diseased plants does not pass down to the new tubers as it normally should, but remains in the leaf in the form of starch. Other symptoms of abnormal physiology have been discovered. But whatever the primary cause of these disturbances, the effect is sufficiently great to influence the seed-tubers profoundly, since tubers produced by affected plants give rise to diseased plants the following year. The disease, therefore, may, in a somewhat loose sense, be said to be inherited.

In this country the most commonly accepted explanation of the origin or cause of leaf-curl is that it is due to the use of over-mature seed. Such a condition in the tubers might arise as the result of cultivation in dry soils, particularly in those



FIG. 1.—Potato Leaf curl. A mild attack showing curling confined to the lower leaves; this is accompanied however by a decided reduction in crop. Tubers from such plants should not be used for seed purposes as they will give rise to plants showing the disease in a much more severe form and with a very poor yield.



FIG 2.—A more severely attacked plant, showing curling of all the leaves. The yield here is still further reduced, and in extreme cases there is practically no crop at all.

which become unduly warm in summer ; or it might be due to a sudden check owing to the occurrence of a dry spell during the period prior to ripening. The fact that seed saved from the southern, drier and warmer parts of England is more subject to leaf-curl than Scotch or Irish seed, as well as the circumstance that curl in the south may sometimes be largely avoided by lifting the crop of tubers for seed before maturity, appears to lend some support to this view. It is believed, however, that these conditions are secondary, and that the primary cause must be sought in an entirely different direction.

The Dutch plant pathologist Quanjér has proved that leaf-curl can be communicated from one plant to another by grafting ; and he is of opinion that the disease is due to the presence of a virus which is capable of being inoculated into the plant. Exactly how this infection comes about in nature is not known. Insect bites may possibly carry the virus. In any case it appears that not only does infection take place more extensively in dry, warm climates, but also that infected plants suffer much more severely in such climates than under cooler and more congenial conditions. Further, it appears from the researches carried out in Holland, and also in Canada, that healthy plants growing in close proximity to diseased ones are very liable to become infected.

Control Measures.—As the disease is perpetuated by means of the " seed " it is of the utmost importance that *no seed should be saved from affected plants*. Not only should tubers from dwarfed or distinctly curled plants be rejected for seed purposes, but also those from all plants showing curling of the lower leaves.

In cases where potatoes are specially grown for seed purposes a definite practice should be made of *roguing the crop* each season for leaf-curl. This should be done early (June or July). If this course were followed a higher level of seed-quality would be obtained, and the infection of sound plants from the diseased ones, which, according to recent investigations, is very liable to take place, would be prevented.

In the case of gardens and small holdings it is *not advisable to save any seed from crops on the lighter soils in the drier and warmer parts of the country*. It is well known that potatoes grown in such areas develop leaf-curl extensively, and that even crops from " once grown " Scotch seed (*i.e.*, seed saved the first season after being received from Scotland), showed marked deterioration and reduced yield. In all such localities fresh, northern seed should be obtained each year.

PROFITABLE APPLES FOR MARKET.

THERE is at the present time a heavy demand for fruit trees for planting purposes, and this demand is likely to continue. It is desirable that prospective fruit growers should be well informed as to the profitableness or otherwise of the different varieties available, so that they may place their orders early. The Ministry's Leaflet No. 134, as recently re-written, is therefore here reproduced for the information of those interested. It should be read in conjunction with Leaflets Nos. 283 (Picking and Storing Apples and Pears) and 148 (Planning and Planting a Fruit Plantation).

Trade catalogues offer such a bewildering choice of varieties that the prospective apple grower often finds it difficult to make a satisfactory selection. The difficulty is increased by the fact that the descriptions given are usually confined to the good points. The object of this article is to give an impartial description of both the good and bad qualities of the varieties of apples commonly grown and generally to assist the grower in choosing the varieties most suitable for the purpose he has in view.

Although the varieties selected for fresh planting should be chosen mainly on the lines indicated below, the ultimate effect of the produce of these plantations on the British apple-growing industry as a whole should not be lost sight of. In order that home supplies may be in a favourable position to compete with imported produce it is most important to eliminate the many varieties now grown which are not of first-rate market importance, and to confine the selection to a few standard sorts, so that a considerable bulk of these varieties may be produced at home annually. If standardisation of varieties on these lines be combined with up-to-date methods of grading and marketing, British produce, by reason of its lower cost of production, must eventually replace a large proportion of that imported.

FACTORS INFLUENCING THE CHOICE OF VARIETIES.

(1) *Marketing*.—Where the fruit is disposed of through the wholesale markets, only five or six varieties at most should be chosen; on the other hand, the grower who sells his fruit direct to retail shops, or who has a local connection to maintain, is obliged to make a wider selection, so that the supply

both for dessert and cooking purposes may be continuous throughout the season.

In both cases, early and late varieties should be planted in such proportions that the marketing period is prolonged as much as possible. Provided efficient storage room is available, it is best, to plant the largest possible proportion of late varieties possessing long-keeping qualities, for the prices realised in December, January, and onwards are generally more remunerative than earlier in the season; this course has also the advantage that apple packing during these months ensures wet-weather work for the regular orchard hands.

(2) *Method of Cultivation*.—As a general rule, and provided that the land is suitable, the strong-growing culinary sorts, which form large heads and produce quantity rather than quality are best grown as standards or half-standards; on the other hand, the weaker culinary sorts, which make small trees, and dessert varieties, in which quality is as important as quantity, should be grown as bush trees. With the present condition of the labour market, it is a point in favour of standards or half-standards that the width of planting facilitates horse or mechanical cultivation, while, when in bearing, they produce a larger bulk of fruit at a lower average cost than bush trees. On the other hand, they take a longer time to come into bearing, and the quality, especially of dessert sorts, is not so high. Standards and half-standards planted 30–40 ft. apart allow for intercropping with market-garden crops or bush fruit (gooseberries, currants, etc.) for ten to fifteen years after planting, and with standards the costs of cultivation can then be reduced to the lowest limit by laying the land down to grass.

For cordons only high-quality dessert varieties, giving good results from spur pruning, should be considered. Several culinary varieties, such as Lord Derby or Grenadier, grow well and yield good crops as cordons, but the fruit does not command prices which will repay the cost of the extra attention required.

(3) *Locality and Soils*.—Some of the chief market varieties are definitely known to dislike certain situations and types of soils. For this reason local knowledge should always be followed closely, especially in relation to the power of a variety to resist disease. In some districts certain varieties are very susceptible to apple canker, and unsuitable soil and climatic conditions are usually first manifested in a weakened power of disease resistance. It is useless to plant any variety which is known locally to scab or canker badly.

LIST OF VARIETIES WHICH SUCCEED IN MOST LOCALITIES.

Varieties suitable for Standards.

<i>Culinary.</i>		<i>Dessert.</i>
Bramley's Seedling.	Beauty of Bath,	} More successful as bush or half- standards.
Newton Wonder.	Worcester Pearmain,	
Annie Elizabeth.	Allington Pippin,	
Lord Derby.		

Varieties suitable for Bush or Half-standards.

<i>Culinary.</i>		<i>Dessert.</i>
Early Victoria.		Mr. Gladstone.
Grenadier.		Beauty of Bath.
Stirling Castle (bush).		James Grieve.
Lord Derby.		Worcester Pearmain.
Lane's Prince Albert (bush)		Rival.
Bramley's Seedling (too strong for bush).		Allington Pippin.
Newton Wonder.		

Varieties suitable for Cordons.

<i>Culinary.</i>		<i>Dessert.</i>
Beauty of Bath.	Allington Pippin.	
James Grieve.	King of the Pippins.	} see below.
Worcester Pearmain.	Cox's Orange Pippin.	
Rival.	Egremont Russet.	

Varieties not recommended for extensive planting but which do well in some districts:—(They should not be chosen unless they are known to succeed locally, and even then should seldom be planted except for special purposes.)

<i>Culinary.</i>		
Ecklinville Seedling	..	Standard, half-standard, or bush.
Graham's Royal Jubilee	..	Half-standard or bush.
Lord Grosvenor	..	..
Warner's King	..	Standard, half-standard, or bush.
Bismarck	..	Half-standard or bush.
<i>Dessert.</i>		
Cox's Orange Pippin	..	Bush or cordon.
Lady Sudeley	..	" "
King of the Pippins	..	" "

DESCRIPTION OF CHIEF VARIETIES OF APPLES.

ALLINGTON PIPPIN. Oct.—Nov.

A dessert variety following Worcester Pearmain in season. Medium. Lemon yellow flushed and striped with bright red; carries well and is a good regular cropper. A fairly strong grower with a spreading habit. Best grown as bush or cordon on dwarfing stock. Subject to scab, mildew and Woolly Aphis, but usually free from canker. Does not colour well on some soils. More colour is obtained when the centre of the tree is kept open. Is rapidly becoming a standard market variety.

ANNIE ELIZABETH. Dec.—Feb.

A valuable culinary variety. Large, dark green with reddish-brown flush; of good quality and carries well. Is *slow bearing*, and for this reason is often neglected, but crops well, especially in the west, when once it starts; growth strong and very erect. Suitable as a permanent standard or bush on dwarfing stock. Too slow in bearing for use as a filler. Comparatively free from scab and canker.

BEAUTY OF BATH. Aug.

The best early dessert variety. Small to medium, orange, prettily striped and spotted with red. Quality excellent, but the fruit ripens unevenly and should be picked over several times. Carries well, but must be marketed soon after picking. Inclined to be a shy cropper. Succeeds on either "free" or dwarfing stock, but does best as a bush in the latter. Growth strong, spreading and irregular, often causing trees to be one-sided. Chiefly used as a permanent tree; also suitable as a cordon. Free from canker and scab, and succeeds in most districts.

BISMARCK. Oct.—Dec.

Culinary variety of good quality. Large, heavily flushed with dark crimson. Keeps and carries well and is a good cropper. Suitable for bush and half-standard. Fairly strong grower, moderately upright in growth. Does better in the North than in the South. Inclined to scab and mildew.

BLENHEIM ORANGE. Nov.—Feb.

A valuable variety of excellent quality for cooking or dessert. Medium to large. Golden yellow with a flushed cheek and russeted. Carries and keeps well. Takes some years to come into bearing, and for this reason is seldom planted now except in grass orchards. A strong grower and forms a spreading tree. Free from disease.

BRAMLEY'S SEEDLING. Nov.—March.

The best late market culinary apple. Large, flat, green, sometimes with a dull red cheek. Excellent quality and commands the highest price of all culinary apples. Carries and keeps well, especially the smaller samples, which, if stored until after Christmas, command a high price. A heavy cropper when trees are formed, but inclined to be biennial in habit. A very strong grower and forms a large, spreading tree. Succeeds best as standard or half-standard on "free" stock, but for bush trees must be grown on dwarfing stock. Very free from scab, canker and other fungoid diseases. Succeeds over a wide range of soils and situations, and is the best variety with which to top-graft unsuitable sorts. This should not be confused with Crimson Bramley, which is inferior.

COX'S ORANGE PIPPIN. Nov.—Jan.

A dessert apple of the best quality. Size medium to small. Round, orange, shaded and striped with dull red. Carries well. A very unreliable cropper and only a moderate grower of somewhat spreading habit. Should be grown either as bush or cordon on dwarfing stocks. Very subject to scab, mildew and canker, especially on heavy, cold soils. Seems to succeed best on gravelly soils. As a commercial variety is a speculation.

EARLY VICTORIA or ENNETH EARLY. Aug.—Sept.

Good quality early cooker. Medium size, green (Codlin type). Bears freely at an early age and is liable to overcrop. Pays to thin when the thinnings are large enough to sell. Growth of medium strength and of upright habit. Requires free stock and naturally forms a good bush, but will also do as half-standard. More suitable as a "filler" than for a permanent tree. Usually free from both apple scab and canker.

ECKLINVILLE SEEDLING. Aug.—Sept.

Early culinary variety of good quality. Large, greenish-yellow covered with large, scattered dots. Soft, and does not keep or carry well if allowed to get too ripe. Prolific and strong, with a more or less upright growth, forming a large standard or bush. The latter should be on a dwarfing stock. Too strong for a filler. Very subject to canker and scab, and for this reason should not be planted unless known to thrive in the district.

EGREMONT RUSSET. Aug.—Sept.

A useful variety for local dessert trade, but liable to be small except from cordons. Golden-yellow covered with russet. Carries well and is a good cropper. Growth moderate, compact and inclined to be upright. Form as very useful bush or cordon, but is no good as a standard.

MR. GLADSTONE. Aug.

Early dessert with season the same as Beauty of Bath. Medium size and highly coloured but quality only fair. Carries fairly well if marketed immediately after picking, but becomes soft and mealy if kept and should, therefore, be sold before fully coloured. Moderately quick bearing and a heavy cropper. Forms a small, spreading tree and should, therefore, be worked on "free" stock. Only suitable for bush or cordon. Often pays better than Beauty of Bath on account of heavy cropping, but its quality is not so good and it should not be grown where Beauty of Bath succeeds. Somewhat subject to scab but usually free from canker. Very useful for local markets.

GRENADEIR. Sept.—Oct.

Good quality early cooker, in season immediately after Early Victoria. Large, light green, travels well. Crops in 5-6 years and thereafter bears heavily. Often pays for thinning. Growth moderately strong and inclined to be upright. Usually best as half-standard or bush on "free" stock. On dwarfing stock can be used as a filler. Bears freely on tips if not "headed in."

JAMES GRIEVE. Sept.—Nov.

Dessert variety with season overlapping Worcester Pearmain. Medium, golden-yellow, faintly striped and flushed with red; quality excellent. Travels well in the North but inclined to be soft in the South. Growth strong and inclined to be spreading. Forms a good-sized compact tree. Suitable as a permanent bush tree on a dwarfing stock and also as a cordon. On some soils very subject to canker, scab, and Brown Rot. Colours badly, especially if trees are not thinned well. In the markets it does not sell as well as its quality warrants, probably owing to its lack of colour and softness.

KING OF PIPPINS. Oct.—Dec.

Fair quality dessert variety. Fruit often very small. Golden-yellow with a faint reddish-brown cheek. Carries well. A good cropper. Growth moderate and more or less upright. Seldom planted now on account of the smallness of its fruit and susceptibility to scab and canker.

LADY SUDELEY. Aug—Sept.

An early dessert variety. Season similar to that of Worcester Pearmain. Good appearance but only of fair quality. Medium, yellow covered with bold crimson stripes. Carries fairly well. Crops rather irregularly. Growth moderate and inclined to be upright. Forms a medium-sized standard but makes a good bush on "free" stock. Usually free from canker but slightly susceptible to scab. Prefers light soils. Sells boldly on the large markets, but is useful for a local trade.

LANE'S PRINCE ALBERT. Oct.—Dec.

Excellent cooker for market, in season after Lord Derby. Large, green, flushed and somewhat striped with red when exposed to sun. Quality and flavour very good. Cooks frothily. Carries well but needs careful handling. Quick bearing and very heavy cropper. Often pays to thin. Must be worked on "free" stock. Growth weak, spreading and crossing. Not suitable for standard or half-standard but only as bush (permanent or filler). Usually free from scab and canker but rather subject to mildew. Succeeds in most localities.

LORD DERBY. Sept.—Nov.

Culinary, very large, green. Season follows Grenadier. Quality good, but does not cook frothily. Crops heavily and carries well. Upright in habit and suitable for permanent tree as standard, half-standard or bush. Sometimes used as a filler. Usually best on "free" stock. Very subject to Brown Rot canker (Blossom Wilt) on twigs, and on some soils inclined to canker. Should not be planted unless known to thrive locally. Sells especially well in Northern markets. Hard spur pruning essential to keep down Brown Rot canker and to maintain size of fruit.

LORD GROSVENOR. Aug.—Sept.

Culinary variety of good quality with season similar to Grenadier. Large, pale, greenish yellow. Carries fairly well if not too ripe. A very heavy cropper and usually requires thinning. Growth weak and comparatively upright. Grown as a bush on "free" stock and useful as a filler. Subject to canker and scab on many soils.

NEWTON WONDER. Nov.—Feb.

The second best late-keeping cooker. Large, golden-yellow, richly flushed with red. Good quality. Carries and keeps well. Small grades, if kept until after Christmas often sells well for dessert purposes. A good cropper but inclined to be biennial in this respect. Growth strong, and forms a large tree more upright than spreading and not quite so large as Bramley's Seedling. Used for permanent bush, half-standard or standard. Bush trees should be worked on a dwarfing stock. Where the situation or soil is unsuitable it is subject to scab, canker and also bitter pit. On soils overlying chalk it succeeds better than any other variety.

RIVAL. Oct.—Dec.

A dessert variety overlapping in season with Allington Pippin. Medium to large, golden-yellow, flushed with scarlet when exposed to sun. Flavour and quality good. Flesh very firm. Carries well. Not a quick bearer but crops heavily when started. A strong grower forming a compact tree. Best grown as bush tree on dwarfing stock or as a cordon. Usually free from scab but inclined to canker. Does not like heavy soils. Has not been grown for market long enough definitely to prove its worth, but shows great promise.

ROYAL JUBILEE—GRAHAM'S. Oct.—Dec.

Good quality mid-season culinary apple, ranking after Lord Derby in market value. Large. Lemon-yellow, sometimes with a rosy flush. Carries well. Rather slow-bearing but old trees crop heavily. Blossoms late and escapes late frosts. Growth spreading, sturdy and of medium strength. Forms a good-sized bush. Suitable for permanent tree or filler. Free from canker. Its shape makes it rather unsuitable for market purposes and it is little known as a market variety.

STIRLING CASTLE. Sept.—Oct.

Useful culinary apple. Season slightly later than Grenadier. Good quality, medium size, yellowish-green. Carries fairly well but flesh inclined to be soft. Very early bearing and a regular cropper. A very weak grower and should be grown as bush on "free" stock. Used as a filler. Trees over 10 years old are very susceptible to canker, and therefore not suitable for permanent trees.

WARNER'S KING. Oct.—Nov.

An excellent cooker. Large, pale yellow. Carries quite well and is a good cropper. Growth strong, forming a large, upright tree. Bush trees should be on dwarfing stock. Does not like cold soils. Is very susceptible to canker, and for this reason should seldom be planted.

WORCESTER PEARMAIN. Sept.—Oct.

Popular and valuable dessert apple of fair quality. Medium to small in size. Orange, often completely flushed into scarlet. Carries well, crops heavily and regularly, and is in great demand. A moderately strong grower of upright habit. Best grown as bush or half-standard on "free" stock. Cankers badly on some soils and is inclined to scab. Always sells well owing to brilliant colour.

QUESTIONS IN PARLIAMENT.

Farms entered on by Agricultural Executive Committees.—In reply to a question by Mr. Hurd, the Parliamentary Secretary to the Ministry stated that the Ministry had in its possession balance sheets showing the financial position with regard to all the farms entered upon by Agricultural Executive Committees and cultivated by those Committees on behalf of the Ministry. It was not considered that there would be any advantage in publishing these accounts or that farmers would be able to draw any reliable conclusions from the figures. The business of the Agricultural Executive Committees was not to show how farms could be worked for profit, but to endeavour to remedy some of the results of long-continued neglect. In many cases this involved heavy outlay before any return would appear. (12th May, 1920.)

Land Cultivation and Increased Wages.—In reply to a question by Sir L. Harmsworth, the Parliamentary Secretary to the Ministry stated that the Ministry had no direct evidence of any land having gone out of cultivation owing to the increased rates of wages, but that the tendency to lay down arable land to grass had, no doubt, been accentuated on that account. (12th May, 1920.)

Meat.—In reply to a question by Mr. J. Davison, it was stated that the estimated quantities of imported and home-grown meat consumed by the civilian population in the United Kingdom for the years stated as under were as follows :—

	<i>Home-killed.</i> <i>Tons.</i>	<i>Imported.</i> <i>Tons.</i>	<i>Total.</i> <i>Tons.</i>
Pre-War years, 1909-13..	1,357,000	750,000	2,107,000
Annual Average—			
1914	1,324,000	689,000	2,013,000
1915	1,356,000	464,000	1,820,000
1916	1,404,000	303,000	1,707,000
1917	1,320,000	232,000	1,552,000
1918	883,000	250,000	1,133,000
1919	975,000	435,000	1,410,000

(3rd May, 1920.)

Advances to Tenants of Small Holdings.—In reply to a question by Commander Locker-Lampson, the Parliamentary Secretary to the Ministry stated that the Ministry had informed Councils that owing to the high prices at present ruling for live and dead stock, fertilisers, etc., the amount of capital required to farm an ordinary small holding which, in December, 1918, was stated to be not less than £12 per acre, must now be regarded as not less than £20. Councils were, however, still empowered to guarantee an advance to their small-holding tenants of an amount equal to the amount of capital otherwise possessed by such tenants. (13th May, 1920.)

Prices of Ground Basic Slag, 1920-21.—The Ministry of Agriculture and Fisheries and the Board of Agriculture for Scotland have come to an agreement with the makers of ground basic slag with regard to the maximum prices to be charged for this fertiliser in the season 1920-21. These prices are the maximum net cash prices for ground basic slag in maker's 2-cwt. bags, delivered in minimum lots of 4 tons in railway

truck or free *ex* barge or ship at purchaser's or consumer's railway station or wharf in Great Britain, or, in the case of shipments to Ireland, the Channel Islands or the Isle of Man, carriage paid to station at port of shipment in Great Britain, less a trade discount to manure mixers, agricultural merchants, makers and co-operative societies. The prices are as follows:—

<i>Percentage (calculated in terms of tribasic phosphate of lime) of total Phosphates.</i>				<i>Price per Ton.</i>
12 per cent. and over, but less than 14 per cent.				82s.
14	"	"	16	89s.
16	"	"	18	96s.
18	"	"	20	103s.
20	"	"	22	110s.
22	"	"	24	112s.
24	"	"	26	115s.
26	"	"	28	118s.
28	"	"	30	121s.
30	"	"	32	124s.
32	"	"	34	127s.
34	"	"	36	131s.
36	"	"	38	135s.
38	"	"	40	139s.
40	"	"	42	143s.
42	"	"	44	147s.

The above prices apply to England, Scotland and Wales, but not to Ireland, and are maximum prices for sales of ground basic slag for delivery between 1st September, 1920 and the 31st March, 1921. In the case of sales of ground basic slag for delivery during June, July and August, 1920, the maximum prices for all qualities will be less than the prices set out above, in accordance with the following table:—

<i>Period for Delivery.</i>	<i>Reduction in the Maximum Prices set out above.</i>
During June, 1920	4s. per ton.
„ July, 1920	3s. „
„ August, 1920	2s. „

As the available quantity of the higher grades of basic slag is comparatively small, farmers should be prepared to accept a correspondingly large proportion of the lower grades.

For sales of small quantities made *ex* merchant's store the following additions may be made to the prices charged for 4-ton lots:—

<i>Quantity delivered.</i>	<i>Additional Price.</i>
1 ton and over, but less than 4 tons	15s. per ton.
2 cwt. „ „ „ 1 ton	1s. 6d. per cwt.
1 cwt. „ „ „ 2 cwt.	3s. „
28 lb. „ „ „ 1 cwt.	4s. 6d. „
14 lb. „ „ „ 28 lb.	6s. „

In the case of sales for delivery to consumer's premises *ex* merchant's shop or store, the cost of conveyance, charged at local rates, may be added.

The other conditions of sale remain substantially the same as in the 1919-20 season, with the exception of slight variations in the amounts of the allowances or additional charges authorised. Full particulars are given in a notice which may be obtained post free on application to the General Secretary, Land and Supplies Department, Ministry of Agriculture and Fisheries, 72, Victoria Street, London, S.W.1.

**Leaflets issued by
the Ministry.**

SINCE the date of the list given on p. 193 of the issue of this *Journal* for May last, the following leaflets have been issued in the *Permanent Series* :—

No. 342.—*The Management of Bulls.*

„ 343.—*Leaflet on Potato Wart Disease, specially prepared for Children who cultivate School Gardens and for Amateurs in Gardening.* (Formerly issued as Food Production Leaflet No. 28.)

„ 344.—*Compound Manures.* (Formerly issued as Food Production Leaflet No. 24.)

„ 345.—*The White Rot Disease of Onion Bulbs.*

„ 348.—*Redemption of Tithe Rentcharge : The Tithe Act, 1918. Income Tax Liability of Landowner and Titheowner.*

Other Leaflets—

A.—316/I.—*Abridged List of Publications.*

A.—318/I.—*A Simple Apparatus for "Gassing" Rats.*

Leaflet No. 61, *Sheep Scab*, has been issued in Gaelic.

In addition the information in the following leaflets has been revised and brought up to date.

No. 23.—*Potato Disease ("Blight") and its Prevention.*

„ 38.—*The Carrot Fly.*

„ 53.—*The Pear Midge.*

„ 63.—*Destruction of Charlock.*

„ 70.—*The Renovation of Neglected Orchards.*

„ 87.—*The Die-back (Cytospora) Disease of Fruit Trees.*

„ 92.—*Bunt and Smut in Wheat.*

„ 120.—*Peach Leaf-curl.*

„ 129.—*Winter Egg Production.*

„ 133.—*Powdery Mildew of the Vine.*

„ 134.—*Profitable Apples for Market.*

„ 164.—*Potato Leaf-curl.*

„ 257.—*The International Institute of Agriculture : Its objects and its Publications.*

„ 315.—*Suggestions and Chart for the General Cropping, Manuring and Cultivation of Allotments.*

„ 329.—*Redemption of Tithe Rentcharge and Corn Rents : The Tithe Act, 1918.*

The following leaflets have been withdrawn from circulation :—

Permanent Series—

No. 124.—*The Asparagus Fly.*

„ 138.—*The Pine Weevil.*

Food Production Series—

No. 4.—*Jam Making in War Time.*

„ 52.—*The Distribution of Fruit and Vegetables through the London and Provincial Markets.*

Wart Disease of Potatoes: Free Inspection of Crops.—In order to give farmers greater opportunities of raising clean crops of potatoes and of combating Wart Disease, the Ministry has instituted a system of free inspection of immune varieties and the granting of certificates. In districts of England and Wales regarded by the Ministry as suitable for production of "seed," growers may have their crops inspected on application. This arrangement applies only to growers whose area under potatoes is not less than half an acre. In those cases where, after inspection, the Ministry is satisfied that the stock is pure and the crop generally healthy, a certificate to that effect will be issued free of charge. The object of this inspection is to secure, as far as possible, that pure "seed," true to type, shall be available for planting in 1921, in areas certified as "infected areas" under the Wart Disease of Potatoes Order of 1919. Growers should be aware that under this Order, "seed" of immune varieties can only enter such areas after it has been certificated. Certificates will not be issued unless the authorities are fully satisfied as to the purity of the stock and the general healthiness of the crop. A certificate will assist the grower to sell his seed to a dealer, and will facilitate the entry of such seed into infected areas.

Applications for the inspection of growing crops must be made on forms provided for the purpose, which can be obtained from the Ministry, 72, Victoria Street, London S.W. 1. These forms, duly completed, must be returned to the above address, not later than the 1st July, 1920.

Foot-and-Mouth Disease.—All general restrictions as regards the outbreaks of disease at Frettenham, near Norwich, and Elmley, Isle of Sheppey, which were recorded in the last issue of this *Journal*, were withdrawn as from the 20th May, and 27th May, respectively.

On the 1st June, however, outbreaks of Foot-and-Mouth disease were confirmed at Bowthorpe, near Norwich, and at Broomhill, near Rye, East Sussex. As regards the former of these outbreaks, no developments have occurred, but in the latter, disease was confirmed to exist on the 4th and 5th June on two sets of premises in the immediate vicinity of the premises at Broomhill.

The usual orders prohibiting movement over a wide area were issued on the 1st June. It is to be specially noted that the new outbreak at Bowthorpe unfortunately necessitates the re-imposition of restrictions over a large part of the area freed from restrictions on the 20th May.

Rabies.—No outbreak of Rabies has been confirmed in a home dog since that at Colchester on the 8th April last, but it has been definitely confirmed that Rabies existed in a dog landed from abroad on the 16th December last, which was undergoing quarantine on approved veterinary premises in accordance with the provisions of the Importation of Dogs Orders. The symptoms of the disease did not appear until the dog had completed nearly 4 months' quarantine.

The muzzling restrictions which applied to a small area around Stebbing in Essex were withdrawn as from the 20th May. With this exception the position remains unchanged since the last issue of this *Journal* was published.

Weather Forecasts for Farmers.—The Meteorological Office will, as in past years, supply forecasts of weather by telegraph to persons desirous of receiving them, upon payment of a registration fee of 1s. and the cost of the telegrams, computed at 1s. per message.

The forecasts are drawn up at 10.30 a.m., 4.0 p.m., and 9.0 p.m. (summer time). Forecasts issued at the morning hour refer to the period covering the afternoon of the day of issue and the morning of the following day. Those issued in the afternoon and evening refer to the whole of the following day. All the forecasts include a Further Outlook of the probable weather beyond the 24-hour period whenever such a Further Outlook can be given.

Notifications will also be issued by telegram when conditions indicate that a spell of several days fair weather is likely, and again when the spell is about to break up. For this service a fee of 6d. is charged for telegraphy. A minimum deposit of 5s. against which the charges may be booked is required.

Applications for regular forecasts (as distinct from Spell of Notifications) should specify the hour of the forecasts desired (or hours if more than one telegram daily is required). They should be sent to the Director, Meteorological Office, Air Ministry, London, W.C.2, and should be accompanied by a cheque or postal order payable to the Meteorological Committee to cover the cost of the telegrams for the period during which the forecasts are to be sent.

Further particulars and printed forms of application may be obtained from the Director of the Meteorological Office.

Applications by telegraph for single forecasts should be addressed to "Weather, London," and the reply should be prepaid.

Fream Memorial Prize.—The Fream Memorial Prize, which is annually awarded by the Ministry to the candidate who obtains the highest marks in the examinations for the National Diploma in Agriculture, has been won this year by Mr. Wm. Caldwell, of Burnhouses, Kilmarnock, a student of the West of Scotland Agricultural College, Glasgow.

The value of the prize this year is about £7 10s., which is to be devoted to the purchase of books.

New Chairman of Agricultural Wages Board.—Sir Ailwyn Fellowes, K.C.V.O., K.B.E., has resigned his position as Chairman of the Central Agricultural Wages Board, and the Minister of Agriculture has appointed Mr. Collingwood Hope, K.C., C.B.E., to succeed him.

May Journal Erratum.—In the issue of this *Journal* for last month, p. 123, line 33, for the word "Coombs" read "Quarters."

THE JOURNAL OF THE MINISTRY OF AGRICULTURE

Vol. XXVII. No. 4.

JULY, 1920.

NOTES FOR THE MONTH.

PUBLIC moneys to the extent of about £80,000 in respect of the current financial year have been voted by Parliament to the Ministry for the maintenance of agricultural research. It may not be out of place, therefore, to indicate briefly the policy adopted in administering grants under this head.

Agricultural Research.

The bulk of the money goes to the various Research Institutions established throughout the country, each of which concentrates attention on a particular group of subjects. Thus, questions relating to the feeding of farm animals, the breeding of new varieties of cereals and other farm crops, and the breeding of small animals such as rabbits and poultry, are dealt with at the Research Institutes attached to the School of Agriculture at the University of Cambridge. Fruit-growing problems receive attention at the Horticultural Research Station (the National Fruit and Cider Institute) attached to the University of Bristol, and, on a somewhat smaller scale, at the East Malling Fruit Experimental Station associated with Wye College, Kent. The diseases of farm animals form the subject of research at the Royal Veterinary College in London, as well as at the Ministry's Laboratory at Addlestone,

Surrey, while tape-worms and kindred enemies of domestic animals, both in this country and abroad, are studied at the Helminthological Institute attached to the University of Birmingham. The Rothamsted Experimental Station at Harpenden possesses extensive equipment for the detailed study of problems connected with the constitution and bacterial fauna of the soil, and the nutrition and diseases of plants. Questions connected with the economic side of farming, including, of course, agricultural costings, are dealt with at the Economics Research Institute associated with the University of Oxford. Problems of dairy husbandry and the production of milk occupy attention at the Dairy Research Institute at Reading. In addition, several lesser Stations are engaged on special groups of problems; for example, the University College of Wales, Aberystwyth, has recently established a Chair of Plant Breeding, and has started work promising to be of great importance in connection with the breeding of clovers, grasses and other forage crops. Experiments in connection with glasshouse crops are conducted at the Waltham Cross Experimental Station, while the habits, life history and diseases of the honey bee are studied by workers attached to the Universities of Oxford and Cambridge.

Provision is also made for the investigation of special problems which lie outside the scope of the Research Institutions. Such problems are bound to arise continually, and if a worker of the requisite qualifications is available, and suitable means for carrying on the research can be found, a grant is awarded to enable him to carry it to a successful conclusion.

The work of the Research Institutions is, in the main, unlimited in its application. The value of the discoveries is not confined to the immediate neighbourhood, nor even, generally speaking, to the country as a whole, but is appreciated throughout the world. There are, however, certain problems peculiar to a particular locality, and to meet the need arising in this connection the Ministry has had in operation for a number of years an Advisory Scheme, under which competent technical experts, known as Advisory Officers, are attached to certain of the Provincial Agricultural Colleges, for the purpose of dealing with the special technical agricultural problems arising in their area. It is also the duty of these men—as the word “advisory” implies—to act as advisory officers among the farmers in the locality on problems connected with

the subject on which they specialise. In practice, it is found that the most important subject on which farmers require expert advice (apart from questions which may be referred to the County Agricultural Organisers) is plant diseases, and it is hoped that Advisory Officers on this subject will ultimately be available in every area. The Advisory Officers in Plant Pathology, as men employed in this work are called, act as the Intelligence Officers of the Ministry in regard to the incidence of plant diseases in their respective provinces, and close co-operation is secured between them and the Ministry's own Technical Advisers on this subject.

Reference may be made to the career offered by agricultural research. Hitherto, it must be confessed, this has been largely a blind-alley occupation. The research worker, properly so-called, must pursue his calling independently of any economic end. Occasionally discoveries are made which bring the work, and the value of it, to the notice of the public, but as a general rule the researcher continues his labours with little hope of encouragement from outside, and is often depressed by finding that several years of patient investigation have been along a path that has ultimately proved to lead nowhere. Valuable and vital as the work is, it rarely comes into the light. The result has been that, hitherto, adequate recognition has too often been either absent or belated. The War, however, has brought home to us that a Nation aspiring to industrial prestige cannot afford to lose sight of that fundamental research which is the only solid basis of industrial progress, and must offer sufficiently attractive emoluments to research workers to build up an adequate service. That the Ministry is alive to this position is indicated by the largely increased grants available to research institutions. It cannot be said that, even now, the salaries granted to research staffs are a true indication of the value of their work to the State, but at any rate an honest endeavour has been made to improve the lamentably low emoluments and prospects which have hitherto obtained, and to afford a reasonable career to men who prove themselves qualified to undertake research.

As a means of recruiting the research service, the Ministry has resumed the Research Scholarship Scheme which was in operation before the War, and a certain number of scholarships will be offered each year to men who have shown capacity for advanced work in this direction.

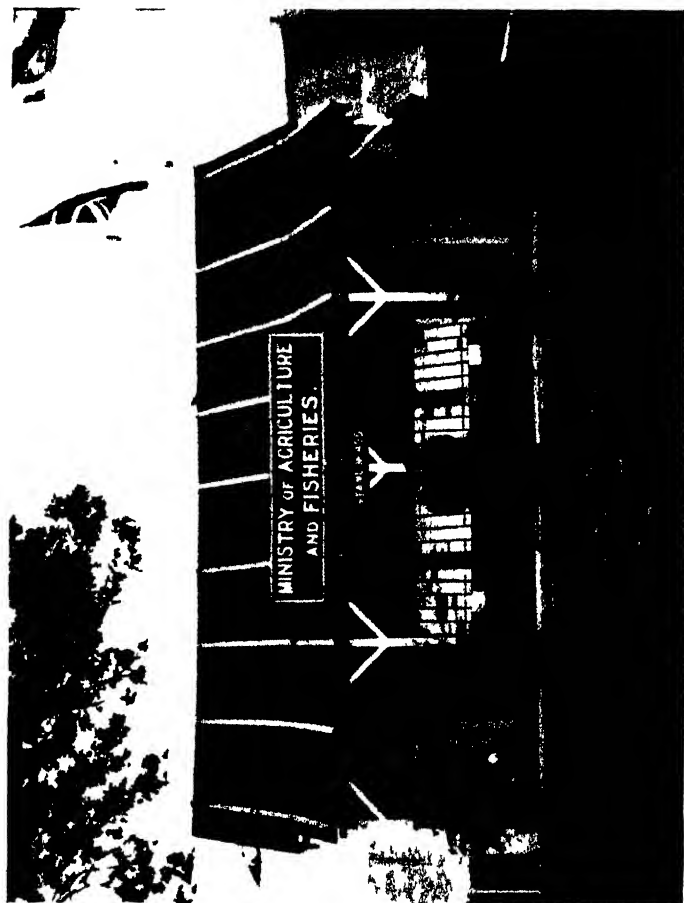
THE Ministry was well represented at the Royal Agricultural Show at Darlington. The Pavilion occupied a prominent position, and from the opening hour visitors came in large numbers to see the various exhibits. The leaflets and *Journal* of the Ministry were displayed attractively, and copies of the speech delivered by the

**Ministry's Pavilion
at the
Royal Agricultural
Show.**

Minister at Harpenden little more than a week before the Show opened were available for free distribution. Photographs and charts afforded much information about agricultural machinery, land cultivation, agricultural education and dairying. There were models of the cottages that are being set up on the Ministry's settlements. There were exhibits showing the value of seed testing, the work of bees, the equipment of land workers, noxious seeds, harmful insects and plant diseases. Excellent maps showed the position of various research and experimental stations throughout the country, and some space was given to the publications of the Agricultural Wages Board.

Nothing could be more gratifying than the numbers of visitors attracted by the Ministry's Exhibit, and the interest shown therein. The crowds that thronged the Pavilion, however, gave the surest indication that in future it will be necessary to devote far more space to the display if the public is to derive full benefit from this means of instruction. If all the branches of the Ministry's work are to receive a thoroughly adequate setting so that inspection of exhibits on any individual stand may be easy and unhampered, all risk of overcrowding must be obviated. It might be said that the Pavilion space would have been quite adequate had a smaller range of subjects been dealt with, but that would be to reduce the efficiency of the undertaking and to do less than is sufficient to meet the proper needs of the occasion. The public interest is not at all likely to fall off, and it has undoubtedly been stimulated to a very great extent by the agricultural developments of the past few years and by the prominent position into which British agriculture has been forced by the War. There can be no doubt that the public interest only needs a proper opportunity to expand, and with that expansion the Ministry's representation at the Royal Show will require extension upon a generous scale in order that justice may be done to the ever-growing list of its projects for the welfare of agriculture.

The demand for the Ministry's publications at the Show was very satisfactory, no less than 45,000 leaflets being distributed free, while in addition a large number of publications were sold.



Ministry of Agriculture Pavilion, Royal Agricultural Society's Show, Darlington.

Machinery and Implements for Food Production. DURING the winter of 1916-1917, when the Government decided that the greatest possible area of land must be brought under cultivation, the Food Production Department was organised to carry out the policy. It soon became apparent that to overtake the work properly, farmers would require great assistance in the shape of machinery, horses and implements, as the farming machinery and implements available were insufficient, and the War had made a tremendous call on men and draught horses. The only alternative was to concentrate for the greater part on mechanical cultivation. Very few tractors were to be found in this country, and these were mostly experimental, but a start was made by hiring available machines, and by obtaining the loan of heavy caterpillar tractors from the Russian Government, until such time as large numbers of up-to-date tractors could be procured. In all, 666 machines were thus obtained. At the same time, arrangements were made to purchase sufficient machines to supply other Government Departments, and private owners who could make full use of them. In all, 5,180 tractors were used for the Department's Scheme, while other users were supplied with 5,628. Though the Food Production Department desired to foster the trade in this country, it was found that agricultural engineering firms were fully employed on munition work, and that this country could undertake the manufacture of only 645 tractors and a limited number of implements. This left no alternative but to turn to the United States of America for the bulk of the required equipment. Trials had already proved the need of a lighter machine, and accordingly 6,000 Fordson tractors, 2,600 Titan tractors, and other tractors of American make, were ordered. The wisdom of this policy has been proved by the demands made for these tractors, which are still in steady request. In all, three English and thirty imported types of tractors were tried by the Department. With a view to standardisation of spare parts, attention was concentrated on four makes, Clayton and Shuttleworth, Saunderson (English makes), and Fordson and Titan (U.S.A.). Certain discarded machines had proved useful, but the types named had preponderating merits. It is noteworthy, as confirmation of the Department's choice, that very few of the discarded types were represented in last year's trials at Lincoln.

The supply of implements was difficult owing to the many different soils and to local prejudice. For use in connection

with the Fordson tractor, the Oliver Plow Company designed a special plough, giving every satisfaction when the width of furrow and form of breast had been adapted to English conditions. Twenty-five other types of plough were tried with tractors other than Fordson's. Of the English makes, Ransomes', Howard's and Saunderson's did very well. Of imported implements used by the Department, Cockshutt's and Hamilton's found most favour. Before the War the few English tractor ploughs in use were of the old rigid type, and the British manufacturer did not quickly realise that the future lay with the self-lift plough. Other implements used with tractors were cultivators, disc harrows, furrow pressers, trailer boxes and small vans. Useful auxiliaries of the supply were lubricants and spare parts.

On heavier land the steam plough was used. Of these there were in England about 500 sets, not employed to the greatest advantage. Steam ploughing was quickly organised so that the sets should be fully employed, especially for breaking up grass land. As there was ample scope for other sets, a contract for 65 steam ploughs was placed, and these were sold to the contractors best able to secure the full employment of the machines. For small fields and hilly land, and to assist small farmers, the Department secured 11,694 horse ploughs, with harness and implements.

Having assured greater corn production, the Department then made provision for threshing. It was found that the country was not only short of threshing machinery, but that the existing machinery was badly distributed. Four hundred and thirty-six threshing machines were therefore ordered, and the distribution was made more suitable to the prevalent conditions. There was work for still more machinery, but it was impossible to secure the machinery from firms already taxed to the utmost with other work. In harvesting plant there was also a great shortage, and provision had to be made for 6,500 binders, 4,218 of which were used for County Executive Committees and the remainder released for sale. All sales were subject to the approval of the Department, whereby it was ensured that the machines should go to the counties that stood most in need of them.

The following figures show the machinery, implements and accessories provided by the Department:—

Tractor Scheme.
 10,802 Tractors.
 20,733 Ploughs.
 1,677 Cultivators.

Steam Tackle.
 65 Complete Sets.
 436 Threshing Machines.

<i>Tractor Scheme.</i>		<i>Horse Scheme.</i>	
1,758	Disc Harrows.	11,694	Horses with Harness.
1,078	Trailer Boxes.	6,500	Binders.
249	Tool Boxes.	10,240	Ploughs.
106	Land Pressers.	250	Potato Diggers.
960	Ford Box Vans.	367	Mowers and Reapers.
131	Motor Cars.	3,684	Rollers.
109	„ Cycles.	2,590	Cultivators.
6,318,532	gal. Paraffin.	2,239	Drills.
1,011,868	„ Petrol.	576	Furrow Pressers.
773,880	„ Lubricating Oil.	5,500	Harrows.
264,544	lb. Grease.	1,658	Carts.
		1,604	Wagons and Lorries.
		114	Spraying Machines.

Shortly after the Armistice it was considered desirable that the Government operations should cease, and that the whole of the acquired plant in their hands should be disposed of, but in such a way as not to upset any arrangements already entered into by County Executive Committees, and also to give farmers who knew the machinery and accessories an opportunity of acquiring them. The majority of counties decided to commence disposal early in 1919, but a few counties were so committed that they were compelled to continue up to the end of the 1919 harvest. All work definitely ceased, however, on 30th September last, and the whole of the stock has now been disposed of. Over 1,000 sales have been held in market towns convenient to the place where the materials had been used, and in most cases farmers were the purchasers.

Apart from the provision of the above plant for the purpose of prosecuting their scheme, the Department undoubtedly did a very great service to farmers, as for a considerable period of the War little or nothing had been done by manufacturers in this country—who were engaged on other work—to replace wastage and to supply the need for new implements, and but for those made available for farmers by the Department, a very difficult situation would have arisen. Further, the Department's Tractor Scheme, as is generally recognised, has hastened mechanical cultivation by many years. Before the Department embarked on their Scheme it is doubtful whether there were 500 tractors in this country, whereas it is fairly safe to say that there are now 20,000, and that the character of implement yards all over the country has been entirely transformed. The sum realised from the sale of the machinery, horses and implements above referred to shows that only a depreciation of 30 per cent. occurred on the purchase amount, which is very gratifying when it is remembered

that the materials received the roughest treatment in breaking up hard ground and rough handling by makeshift drivers and mechanics.

* * * * *

FOR some time past the Ministry has given attention to that very interesting auxiliary to horse breeding, the mountain or **The Mountain Pony**: moorland pony. Every year pony stallions are brought to shows for judging and **Its Value to Agriculture.** veterinary inspection, and the best and most typical specimens of the breeds which it is desired to perpetuate are awarded premiums. These premiums, however, are awarded only in those districts in which Regulations under the Commons Act, 1908, have been made and are enforced, or where, as in the case of the New Forest, similar regulations are in force to prevent undesirable stallions from roaming at large. Hardy ponies run wild on the mountains, moorlands and commons of Wales, on Dartmoor, Exmoor and in the New Forest, where they have roamed for many generations. Their excellent blood can be traced in the finest varieties of the hunter, the racehorse, the hackney, and the polo pony, while the mountain pony itself is often the best draught animal that the small holder can desire.

Strictly defined, a mountain or moorland pony is one whose ancestors have lived half wild on mountain, moorland and common for at least three generations. All breeds have probably a common origin—the ancient British pony—but they have now become so differentiated as to constitute separate breeds. The differentiation arises from such causes as the selection for the particular kind of work they have been required to perform; the attempts that have been made from time to time to improve the breed; too close in-breeding; and breeding from immature, unsound or aged stock. The two causes last mentioned have tended to bring about deterioration, and on this matter it has been said that the history of any breed of ponies is the story of man's neglect of them and his interference with their freedom. The better policy now in force promises a steady improvement in a stock too valuable to be left uncared for. It is sufficient testimony to the vigour, vitality and native excellence of the pony that he is still found in so perfect a state upon his native pastures. He can live where sheep and cattle only die; he has every instinct sharpened by self-preservation, every limb tested by exertion, and he fights his battle unaided, even in the restricted pastures of wire-enclosed mountain spaces. These ponies, bred in the

open, are the natural reservoirs from which our national breeds of light horses are derived, and from which these breeds re-invigorate temperament, courage and resource. The value of the mountain and moorland ponies as a factor in the breeding of English light horses depends upon the purely natural conditions of their life in the forest, on the hills and on moors. Amid adverse conditions, they possess resource, endurance and courage, as well as the hardiness of constitution and soundness of stamina that make the infusion of their blood into other breeds so powerful for good. Their ancestral strain can be traced in the English racehorse, together with the blood derived from the Great Horse of England and from the Barbs of Africa, Arabia, Syria and Turkey. In the eighteenth century, ponies were largely used for racing, and gave ample evidence of blood and courage. Towards the end of that century they had received a large mixture of Eastern blood, and were famous as racehorses proper. These ponies came chiefly from the Fell districts of Westmorland, Cumberland, Wales, Exmoor and the New Forest. Proof of their prowess on the course exists in the General Stud Book, where records, a hundred and 'hirty years' old, confirm the mixed origin of the English racehorse, which was not derived, as is generally supposed, from pure Eastern strain. The fact is, rather, that the Eastern blood gained greatly by its admixture with pony blood. The first reference to the influence of native ponies on the racehorse dates from the reign of James I., and Gervase Markham makes special note of the mental qualities of a racing pony of native descent. He attributes these virtues to the wild, natural life led by the pony's ancestors. Breeders are aware that the thoroughbred, now an established race, can receive no further benefit from the Arab or the pony. In the cases of the hunter, the polo pony, and the hackney, however, the opportunity of improvement still exists. For these, their breeders still seek finer action and greater endurance, which, fortunately, are obtainable by a recurrence to the original pony ancestor of the modern thoroughbred. Infusion of pony blood from mountain and moorland reservoirs is required to re-invigorate our light horses.

* * * * *

DECONTROL of home-produced meat and live stock became effective on 4th July, when the guaranteed price to the British farmer—the basic fact of live stock control—ceased. The guaranteed price had been in operation since 27th December, 1917. The original guarantee was to have expired at the end of

**Decentral of Meat
and Live Stock.**

September, 1919; but the unsettled state of affairs at that time, and the failure of the general expectation that equipoise would be recovered, both in regard to supplies and prices, although nearly a year had elapsed since the signing of the Armistice, caused the Cabinet to decide on the continuance of the farmer's guarantee, in an amended form, until 4th July this year. In spite of the drawbacks and difficulties attendant on the existence of this guarantee, it succeeded in the object which the Food Controller had in view, namely, to ensure a regular supply of home-produced meat. That was its success, particularly in the days of war when the civilian population of Great Britain was mainly dependent on home supplies.

The position on and from 4th July is that the Statutory Rules and Orders in connection with the meat industry, issued by the Food Controller and in force up to 3rd July, have been revoked, with one exception, namely the Bacon (Prohibition of Export) Order, 1918, which will continue in force so far as it relates to bacon, ham and lard. The Orders which have disappeared are as follow:—Slaughterhouses (Licensing); Live Stock (Sales); Live Stock (Restriction on Shipment to Channel Islands); Meat (Dealers Retriction); Meat (Control); Meat (Sales); Meat (Licensing of Wholesale Dealers); London Central Markets; Meat (Licensing of Export) (Ireland); Meat (Maximum Prices); Edible Offals (Maximum Prices); Meat Retail Prices (England and Wales); Meat Retail Prices (Scotland); Imported Meat (Requisition).

By these revocations meat control has been entirely removed; but it is proposed to continue, for the present, three measures of control, viz. :—

- (a) The licensing of slaughterhouses.
- (b) The registration of retail meat dealers.
- (c) The fixing of maximum wholesale and retail prices of chilled and frozen beef and lamb, and maximum wholesale prices of chilled and frozen mutton.

The licensing of slaughterhouses is being carried out under a new Slaughterhouses (Licensing) Order. The Food Controller has issued a circular to every slaughterhouse keeper, explaining that licences issued under the former Order will continue in force and will be deemed to have been issued under the new Order. Any application for a new licence will, in future, have to be made to the Divisional Food Commissioner for the Area in which the premises are situated. The Order gives the Food Controller power to require the making of returns; and in order that information may be available concerning the state

of supplies of home-killed meat, every slaughterhouse keeper will be required to send to the Ministry of Food every four weeks a return of animals slaughtered during that period.

It should be noted particularly that no charges incurred after the date of decontrol of live stock are recoverable from the Central Live Stock Fund. All claims in respect of charges payable by the Central Live Stock Fund, incurred prior to July 4th, should be tendered to the local auctioneer, or other agent of the Central Live Stock Fund to whom such claims are normally forwarded, or else sent direct to the Secretary, Central Live Stock Fund, 100, Cromwell Road, London, S.W. 7, not later than Saturday, 31st July, 1920. No claims received after that date will be entertained by the Fund.

* * * * *

AMONG the demonstrations arranged this year by the Ministry through the medium of the Horticultural Sub-Committees, those framed in the interests of potato cultivation are receiving prominent attention. The important part now played by potato crops on both farms and allotments makes it very desirable that such trials should be conducted widely throughout the country.

Potato Demonstration Plots, 1920.

For several years past, the Ministry's Potato Trials at Ormskirk have been supplemented by trials in different parts of the country, in order to compare the cropping qualities of the more important immune varieties, and to ascertain, also, the varieties most suitable to particular soils and districts. The results, which should be of very great use to potato growers, have clearly demonstrated the value of such trials, and point to the need for the work to be continued in subsequent years in every county, and on the many classes of soils within each county. It is hoped that as a result of this year's trials more precise information on these points may be available.

It was realised that the most valuable results could only be obtained by working all the plots uniformly. A memorandum was therefore circulated by the Ministry to all Horticultural Sub-Committees and to County Agricultural Organisers, setting out definitely the lines on which the trials should be conducted. The Ministry's Scheme provided for (a) farm trials, and (b) allotment trials. The trials themselves were divided into two main sections. The object of the first section was to demonstrate the cropping powers of the well-known immune varieties, and of the second to compare the earliness of cropping qualities of certain early varieties. In the Ministry's memorandum

were set out in detail the varieties of potatoes to be planted and the quantity of "seed" of each variety, the method of preparation of the land, the manures to be used and particulars as to planting.

For section one trials, the following varieties were recommended :—

1st Earlies.—Snowdrop and Dargill Early.

2nd Earlies.—Great Scot and Arran Comrade.

Main Crops.—Majestic, Kerr's Pink, Golden Wonder, Tinwald Perfection and Abundance.

For section two, the varieties selected were :—

Duke of York, Ninetyfold and Epicure (for lands only to which the provisions of the Wart Disease of Potatoes Order of 1919 do not apply), Dargill Early, Arran Rose, King George, Nithsdale, Arran Comrade and Snowdrop.

It is important that all the "seed" planted in such trial plots should be obtained from the same source, as comparison of results, both local and general, would be of little value if the "seed" used had been raised in widely different parts of the country. The Ministry, therefore, arranged for the supply of the necessary "seed" potatoes of the varieties mentioned. It was at first contemplated that the Ministry should purchase the "seed" in bulk and consign it to the various counties as ordered, but in view of the lateness of the season and the practical difficulties involved, it was decided that the "seed" should be purchased direct by Committees from certain specified dealers, with whom the Ministry made arrangements for supplying reliable stocks of the varieties recommended.

It was found difficult to obtain complete supplies, and, consequently, Dobbies Favourite was substituted for Abundance, a variety which it resembles closely. The supply of Epicure was early exhausted.

As a general rule the Horticultural Sub-Committees have entered whole-heartedly into the Ministry's Scheme, and are following carefully the suggestions put forward for the success of the trials, both from a local and national point of view. In some counties, however, no potato trials are being carried out under the Ministry's Scheme, while in others it has not been closely followed. The Ministry's Inspectors are in touch with Horticultural Sub-Committees, County Horticultural Superintendents and Agricultural Organisers, and advice and assistance have been given where necessary.

* * * * *

THE Ministry has just issued the third edition of the Handbook of British Breeds of Live Stock. This Handbook was originally prepared for the Brussels and Buenos Aires International Exhibitions of 1910, with the special object of encouraging the export of British live stock, and a second and revised edition was issued in 1913. The third edition, now issued, contains further and extensive revision, and it is hoped that it will prove of service to all who are interested in live stock, whether for exportation or otherwise.

**Handbook of
British Breeds of
Live Stock.**

The object of this publication is to give an account of the principal characteristics of all the British breeds of horses, cattle, sheep and pigs, with a brief history of their origin, and of some of the principal animals which have formed the foundation stock of the pedigree animals of the present day. It contains particulars of the different breeds of heavy draught horses, light horses and ponies; beef, dual purpose and dairy cattle; longwooled, down, mountain, and other breeds of sheep; and pigs.

A statement of the more important shows and places at which the animals of each breed can be bought, together with an indication of the average prices, is given for the information of prospective purchasers. For further particulars and for the names of individual breeders, readers are referred to the secretaries of the breed societies, whose names and addresses are given.

The Handbook contains 136 pages of letterpress, and is illustrated by some 90 photographs of animals of the different breeds. Copies may be obtained from the offices of the Ministry, 3, St. James's Square, London, S.W. 1, price 3s. 6d. net., bound in paper boards.

* * * * *

It appears from reports which have been received from Officers of the Ministry and from owners of licensed stallions, that in some instances unlicensed stallions are being travelled for service, and in other cases leaders of licensed stallions have not been able to produce the licences

**Production of
Licences
for Stallions.**

when asked to do so. In this connection special attention is drawn to Section 3, Sub-section 3 (b) of the Horse Breeding Act, 1918, under which provision is made to enable police officers to require the production of licences by the persons in charge of stallions which are being travelled for service. Steps have been taken by the Ministry for instructions to be issued

to police officers to exercise their powers and require the production of licences of all stallions which they meet on the road or at markets, fairs, and similar meeting places.

* * * * *

At the Ministry's Exhibit at some of the chief agricultural shows this year are included home handicrafts, the goods exhibited being made by cottagers and other country people. It has been the

**Home-Handicraft
Exhibits.**

Ministry's endeavour to suggest means whereby the women in rural districts should be enabled to engage in occupations that can be carried out at home. It was also desirable that these handicrafts should be taken up by youths and men during the winter months, on days when land work might be impossible. Preliminary experiments proved very encouraging, but they showed clearly the need of organisation. Country people are in no way lacking in the enterprise or imagination necessary for these subsidiary occupations, but in order to make them successful skilled instruction, guidance and organisation are necessary. The Ministry has given attention to occupations other than handicrafts, such as the manufacture of sugar from sugar beet, but these industries are suitable only in districts where factories exist. The case is different with the lighter forms of home-work, as, for instance, basket-making, cloth-making, toy-making, spinning and weaving, the manufacture of small leather goods, and wood-work. Experiments have already shown promising results, and examples of these industries are included in the Ministry's exhibit. It is not intended to set up these village industries as a rival to land work, but rather as a supplement to it, and to give the rural population an opportunity of engaging in interesting and helpful pursuits which may be carried on during their spare time.

* * * * *

THE practice of baling hay on the field has been known in Lancashire for some years, and the experience of last summer suggests that it is likely to be considerably extended. The baler, operated either by

**Baling Hay on the
Field.**

tractor or by steam engine, is stationed in the field, and the hay is baled direct from the windrow or cock. The bales are about 36 in. by 20 in. by 16 in., and weigh from 130 to 160 lb. The hay, at the time of baling, should be in the same condition as if it were intended to stack it in the ordinary way. Some care is necessary in storing bales. Whether stored in a stack on the spot or in a Dutch barn,

they should be stood on their edge and packed as closely as possible, as otherwise there is some risk of mould. Crevices between bales on the outside of the stack should, it is suggested, be filled up to prevent the entrance of air and light. If the hay is properly and tightly baled, however, the risk of mould is considerably reduced.

By this system both labour and storage space are saved, and waste in handling is reduced. The hay is immediately available for transport or for use, and can be easily trucked and re-stacked.

* * * * *

IN view of the value of the lapwing (green plover, or peewit) to agriculture, the Ministry is desirous that the protection afforded to this bird throughout England and Wales should be extended. The lapwing does no damage to crops, and is exceedingly useful to the farmer. It devours snails, slugs, wireworms, beetles, and the larvae of insects such as crane-fly, turnip moth, and yellow under-wing, which prey upon the roots of grass, turnips, and cereals, and it is also of benefit to sheep-owners, in that it feeds on the water-snail that harbours the immature form of liver-fluke, the cause of the liver rot in sheep.

Protection of the Lapwing.

Quite apart from the limitation of numbers by direct destruction of birds, the natural increase of the lapwing is hindered by reason of the fact that the eggs are much sought after as a table delicacy.

The present position is that the killing or taking of the lapwing is absolutely prohibited by Statute as between the 1st March and the 1st August, and on the application of the Councils of the counties and county boroughs concerned, the Home Secretary has made Orders in respect of 39 counties and 36 county boroughs according additional protection to the eggs or the bird or to both.

The Departmental Committee on the Protection of Wild Birds in its report* issued last year recommended that the protection of the lapwing should be standardised and put beyond doubt by the Statute. The clause suggested in the report for this to be carried into effect by legislative action was :—

“Lapwing (Plover).—Eggs and nests to be absolutely protected, except that owners, or persons authorised by them in writing, should be allowed to take the eggs on their own land up to the 15th of April.”

* See this *Journal*, November, 1919, p. 832.

It is the view of the Ministry that the minimum protection which should be accorded to the eggs of this bird is that suggested by the Committee in the clause above quoted.

A copy of Leaflet No. 44 on the Lapwing may be obtained post free on application to the Ministry.

* * * * *

THE attention of the Ministry has again been called to the objectionable practice of "udder stocking," which is still so widely adopted by dealers and farmers

"Udder Stocking." when offering milch cows for sale. The Ministry, therefore, desires to make known to all concerned that, from every point of view, this practice deserves the severest condemnation.

"Udder stocking" is brought about by leaving the cow unmilked for a longer period than that to which she is accustomed. The udder in consequence becomes distended with milk, and so presents an appearance indicative of a milking capacity greater than the cow really possesses.

The purpose of "udder stocking" is, of course, to deceive a prospective purchaser into paying a higher price for the cow than he might otherwise offer, and on these grounds alone is indefensible. Two further considerations, however, need to be borne in mind. In the first place, it is an offence against the law to inflict unnecessary suffering on cows in this manner, and offenders are liable to punishment on conviction. Secondly, "stocking" may seriously reduce the yield of milk from the cow, not only during the period of lactation in which the cow is made to suffer, but after all subsequent calvings. In view of the high price of feeding stuffs, and of all other costs of production, it is especially important at the present moment that farmers as a body should do nothing to impair the productivity of the animal to which they look for a return on their outlay.

The Ministry hopes, therefore, that the practice of "udder stocking" will be severely condemned by all engaged in agriculture.

* * * * *

AT a recent meeting of the Royal Sanitary Institute at St. Helens, Captain J. Woolley submitted several interesting points in reference to rat destruction. His account

Rat Destruction: was based on observations made during the
The Need for rat destruction campaign in Lancashire.
concentrated Effort.

In the course of these operations it was found that rat destruction by areas proves far more successful than fragmentary treatment by poisoning in scattered districts.

There can be no doubt that the rat has some method of communicating to its fellows the warning of danger when something unusual and hostile to itself is afoot, and it is, therefore, essential that all the poisoned baits should be laid on the same day by a screen of men advancing in one direction. The Lancashire campaign has shown extract of squills and barium carbonate to be the most successful poisons used in the county. These chemicals were mixed with fresh bread and sweetened tinned milk. Another most interesting fact disclosed was that during ratting operations, when the poison had been laid, doe rats were found dead on nests containing dead young. Approximately 85 per cent. of the dead found proved to be doe rats. The reason for this appears to be that the female is greedier for the milk-bait on account of aid the milk affords to suckling.

Captain Woolley observed further that before the beginning of the rat migratory season extermination work should be undertaken on as extensive a scale as possible. This should be done before the rats begin their movement to new quarters in the open fields, where food is more plentiful and accessible. After the migration has started it is far more difficult to cope with the pest. The Lancashire authorities found that poison had been effective, and that in suitable places ferreting and trapping also had their uses. The most effective trap had proved to be a wire cage, Brailsford pattern, baited with a raw tomato. No explanation could be offered why this bait should be so readily taken. It was also found that traps of a similar kind usually baited with toasted cheese, fish, bread, oatmeal, meat and tomato, had invariably given the best results when tomato was employed.

The suggestion was made that the Boy Scouts should be interested in the question of rat destruction. If the members of that active body were given lectures on the habits of the rat and its terrible destructiveness, not only would the subject provide a very interesting natural history lesson, but the lectures would also help the scouts to assist the community. Boy Scout corps could in particular be organised for the purpose of concentrated war on the rats all over the country on specified dates as, for example, once weekly.

The discussion of preventive methods, more especially with regard to buildings, called forth the suggestion that premises should be proofed with cement, broken glass and tar applied to the old rat-runs as soon as they were discovered to be "dulled" during the warm weather. It is well that this should be done while the rats are out in the fields, so that at the end

of the summer, when the migratory season recurs and the vermin endeavour to return to their winter homes, they can be caught in large numbers. This can be assured by the laying of poison baits in close proximity to the old runs, and also by the use of bird-lime trays.

Grain stacks, a great harbourage of rats, can be protected by sheets of corrugated iron sunk 3 ft. below the ground all round the stack, together with a fine mesh wire surface fencing 3 ft. high. It has been definitely proved that the rat never burrows more than 2 ft. 6 in. below the ground, so that even where stacks cannot be built upon staddles this method would ensure protection for the grain. Before threshing begins, all standing stacks should be surrounded by wire fencing to prevent the escape of any rats. It was recommended that all threshing-machine owners should be asked to carry wire-netting for this purpose as a part of their ordinary equipment. The same method was proposed for use in ship-breaking yards, whence spread great numbers of rats which enter our ports on board old vessels.

* * * * *

At the meeting of the Norfolk Executive Committee on 12th June, the opinion was freely expressed that the officials of the Ministry had been to blame in that they had not prevented movements of certain sheep, which have led to the disastrous series of outbreaks of foot-and-mouth disease over a wide area of the county. It is natural enough for men who find their businesses threatened by an outbreak of this magnitude to desire to blame somebody, but these opinions, to which so much publicity has been given, would probably have never been uttered had the whole of the facts been before the meeting. Briefly, the circumstances as at present ascertainable are as follows :—

On 12th April, an outbreak of foot-and-mouth disease was diagnosed by the Ministry's officials at Stanninghall, Frettenham, about 6 miles north of Norwich. Unfortunately, the disease had been on the farm for some days before it was reported, but the usual procedure was followed and a considerable area of the district was closed to movements of stock. This outbreak was successfully confined to the vicinity of the infected farm.

On 10th April, two days before the disease was detected at Stanninghall, the owner of some sheep grazing on the adjoining farm had moved them to Bowthorpe, about 4 miles

west of Norwich. No information of this movement reached the officials of the Ministry, though they visited this adjoining farm in the ordinary course of their inspection. This latter farm remained free from disease and has never been under suspicion. The Bowthorpe farm came within the area within which movement was restricted because of the outbreak at Stanninghall. Restrictions were, however, removed from this area on 3rd May, when, owing to the absence of further reports or outbreaks, it was considered that this step could be safely taken.

On 1st June, one of the Ministry's Veterinary Inspectors, on receipt of a report by a Veterinary Inspector to the Local Authority of the County of Norfolk, visited the Bowthorpe farm, and there found that 5 cattle and 8 sheep were affected with foot-and-mouth-disease. He then heard for the first time of the movement of sheep from Stanninghall, and at the same time his inquiry elicited the fact that 570 sheep had been removed about 9th May by road from Bowthorpe to Emneth, a distance of about 50 miles. Their track was immediately followed, and inquiries made on either side of the road they had taken. Unfortunately the mischief had been done, and outbreaks were discovered at various places along the route. In these circumstances heavy slaughtering was inevitable, and the necessity of slaughter was increased owing to the fact that other owners on the route had also by this time moved sheep over the infected track. It is now hoped that the full extent of the infection has been traced and that the outbreak is well in hand.

Clearly the officials of the Ministry had no reason to suspect the farm at Bowthorpe from which the disease was distributed, inasmuch as it is several miles away from the earlier outbreak at Stanninghall and there was apparently nothing to connect the two.

SPEECH BY THE MINISTER OF AGRICULTURE AT THE ROTHAMSTED EXPERIMENTAL STATION.

THE following is the text of a speech by The Lord Lee of Fareham, Minister of Agriculture and Fisheries, at the Rothamsted Experimental Station, on Thursday, 17th June, 1920 :—

LORD LEE OF FAREHAM: Mr. Chairman, my Lord, Ladies and Gentlemen, may I in the first place say how glad I am to see such a remarkable rally of farmers. I could hardly believe it when I was told just now that you all come from Hertfordshire. It seems to me that farmers are really getting interested in agriculture, and what is perhaps more important, the country and the Government are getting very interested in farmers! (Hear, hear.) No doubt you will say it is about time.

The Agriculture Bill.—I hope that Dr. Russell and his staff will forgive me if on this occasion, when perhaps I might be expected to speak on the subject of agricultural research, I think it wiser to leave that for some future time and to deal to-day mainly with the subject which I am sure must be uppermost in your minds; that is, the agricultural policy of the Government as indicated in the Bill which is now before Parliament. I think it is necessary that I should speak on that subject because there appear to be so many perfectly honest, but at the same time exasperating, misunderstandings with regard not merely to the aims and objects of the Bill, but with regard to its actual provisions. I have noticed with regard to agriculture, as with other subjects, that the most severe critics are apt to make a point of not reading a measure or a speech before they proceed to criticise it. It is perfectly clear that a great many of the criticisms which have been directed against this Bill come from people who really have not taken the trouble to understand what the Bill is and what it proposes to do. That is very notably the case with regard to guaranteed minimum prices. Let me say in passing that personally I am very well satisfied with the reception which the Bill has had in the country as a whole and amongst farmers. I am aware there has been no what I might call extravagant enthusiasm for it amongst farmers, but I think that is a clear indication that it is not handing out special favours to one section of the industry or another, and that it is a fair attempt

to frame a moderate balanced policy which will do justice to all concerned in the industry. Certainly the praise which has been bestowed on the Bill, to the effect that at any rate it is an honest effort to help the industry and to keep the pledges which the Government has made, is the highest tribute I would possibly ask for it from any agricultural audience.

The Scope of the Bill.—As Lord Hampden said just now, we are not considering only the farmer, the labourer and the landowner, we are considering also the far greater number of consumers in this country. He was quite right in saying that this Bill is really, in the long run, framed more in the interests of the whole population—the consuming population—than it is in the interests merely of agriculturists. There is, however, one perfectly sound criticism directed against the Bill, and that is, that it has been too long delayed; that it ought to have been introduced before, to have had the full effect which is desirable. Well, you cannot always deal with these extremely complicated, intricate and controversial questions as quickly as you would like, and sometimes the longest way round is the shortest way home. It was certainly worth while—at least I think it was worth while—to try and get a substantial amount of common agreement with regard to this policy before putting it into a Bill and launching it upon the parliamentary seas. I think our judgment in that matter has been justified by the fact that there is a growing measure of support for the Bill, sometimes coming from quite unexpected quarters. I am delighted to see that amongst the supporters of the Bill is now numbered Mr. Horatio Bottomley, a very useful ally, who recognises that it is a Bill which is for the interests of the nation as a whole. Then I was particularly gratified to read in last Sunday's papers that very wise, balanced and judicial support of the Government's policy coming from that great agriculturist, my predecessor, Lord Ernle. He points out most convincingly, not only with regard merely to agriculture, but with regard to national health and financial stability, that the interests of the nation are bound up in a policy of greater home production. He finished up by saying what I am sure will stick: "It does not do to gamble with the food of the people;" and that is what we have been doing up till now in our national agricultural policy. We have been gambling all the time upon the chance—not the certainty—that we should be able to get everything that we wanted from overseas. The idea

was that it did not matter where it came from so long as it was cheap, even if it ruined the British farmer and the whole of the agricultural industry and drove down the wages of the agricultural labourer to starvation point. Thank goodness the nation has seen the light as a result of the War, and whilst they may not have learnt yet all there is to learn, and though it may not have sunk in as deeply as it ought to have sunk in, at any rate I think we are on the right road, as shown by the reception of this Bill. Its principal object, of course, is to encourage arable farming in the national interest, but at the same time it recognises that you cannot encourage arable farming in times of peace, and you cannot get increased production at home, unless you make it *worth the while* of the producer.

Security for the Producer.—The policy of the Bill is to give the producer—the agriculturist—a greater sense of security which will encourage him to greater enterprise, and to do this not by guaranteeing him profits at the expense of the taxpayer, but by giving him a reasonable and fair chance of a profit, and at the same time guaranteeing him against disastrous loss if he engages in a form of farming which means more risks for him and which has often in the past brought him nearly to ruin. We are not seeking to secure for the farmer profits in his business, but we are seeking to expose him to less risks. The Bill in this respect gives what I venture to say has been asked for, not merely by farmers but by nearly all agricultural reformers who have investigated this great question for the last generation. Though the Government measure may not go as far as some would wish, at any rate we claim that it goes much further than anything else which has been offered by any Government, and I do most earnestly ask the farmers of this country to respond, and not to respond only in a small way, but with generosity and patriotism, to the call which now comes to them.

The Minimum Price of Wheat.—I spoke just now about the misunderstandings of what the actual proposals of the Bill are with regard to guaranteed prices. May I add that if after what I am going to say it is still not clear to any farmers in this room, will they ask me questions about it afterwards? I am quite prepared to answer any questions with regard to the Bill to the best of my ability. I do not want anyone to say afterwards that they do not understand what the position is or what the Government is offering. In the first place may I say, with regard to one criticism which has been

frequently indulged in, that the farmer to-day is not being asked to grow wheat at 68s. a quarter. I have read several such criticisms in the last few days: "What is the use of the Government asking us to grow wheat to-day at 68s. a quarter?" The answer is that we are not asking the farmer to do anything of the kind. The 68s. was the figure calculated as a starting point in 1919 by the Royal Commission and referred to conditions which are now past. The minimum price which the farmer will receive in any event for his wheat will be calculated on a sliding scale starting from the 68s. It will either go up if the cost of production increases, or go down if the cost of production falls below the point at which it was when that 68s. was calculated in 1919. You may ask me: "What is the equivalent to that 68s. to-day?" As you know from the Bill, the guarantees do not come into force till next year; but we have made calculations as to what would be the comparative figure to-day, if the guarantees were in force, and we are of opinion—although I must not anticipate the work of the Commissioners—that the equivalent figure to-day would be between 80s. and 85s. Next year it will probably be higher. That, if the guarantees were in operation this year, would be the *minimum* price which the farmer could possibly receive. But above that we give him in connection with these guarantees, for the crop of next year, the equivalent of the free play of the market. (Hear, hear.) At whatever price imported wheat comes into this country the farmer will get the equivalent of that price for his wheat harvested in 1921, instead of being tied down, as he has been recently, to a controlled maximum. What the average world price will be for wheat harvested next year I cannot foretell. The Food Controller has suggested that it may go as high as 140s. In the interests of the community I hope it will not, but it seems almost certain that the price will be well above the average of 100s. at which it stands to-day. Surely then, if the farmer is protected on the one hand against serious loss, if he grows wheat, by a minimum price which to-day could not be less than 80s., and, on the other hand, he is to have the chance of making his profit up to the average world's price, then I venture to say he is being given not merely what he is entitled to, but everything that he has asked for through any of his responsible representatives. That being so, I have no doubt myself, and I am glad to learn in discussing it with leaders of agricultural opinion that they have no doubt, that this inducement will prove sufficient to bring about

a largely increased sowing of wheat this autumn, not merely from motives of patriotism, but simply because it will be well worth the while of the farmer to do it; and after all that is the best inducement.

The Acreage Basis of the Guarantee.—Then, perhaps, I shall be asked: "Why is it that this guaranteed minimum price is based upon the acreage grown rather than upon the amount of crop harvested?" There are two very good reasons for that. The first is an administrative one. It would be utterly impossible to check every quarter of wheat that was grown. It would mean a perfect army of inspectors and checkers all over the country, at every threshing, at every miller's, and I am sure farmers would be the first to complain of any further invasion of that kind. (Hear, hear.) Secondly, it would operate hardly against the man with light land, and we particularly want to encourage the growing of more wheat on the lighter lands. Therefore we take the average production of the whole country at four quarters an acre. If a man only grows two quarters on account of the poorness of his soil he still will receive precisely the same amount of subsidy from the State under the guaranteed minimum price. Of course, he will not receive as much for the sale of his wheat as the man who grows five quarters, but he will get exactly the same guarantee subsidy as everyone else from the Government with regard to the acreage which he has sown. Whilst on this question of the lighter lands may I just say that the only way in which I believe this country can ever be made reasonably self-supporting, the only way in which wheat growing, and, indeed, farming of all kinds, can be made certainly profitable, and the only way in which adequate wages can be paid to the agricultural labourer—the only way in which all those things can be done on an economic basis—is that the average yield of all our crops should be increased. It is in this connection that we find the great value of the work that is being done here by Dr. Russell and his devoted staff and by great scientists like Professor Biffen and others. (Applause.) It is quite clear that it can be done. It is already being done on a small scale, and what we have got to do, by increased grants for education, and increased propaganda, is to make known to the whole body of farmers in this country the special discoveries and productions which have come from the work of these great institutions. That is the chief way in which production can be made more economical.

Science and Economical Production.—You cannot expect to make production more economical by cutting down the

labourers' wages. The higher wage has come to stay, and the way in which it can be paid and can be justified in an economic sense will be by an increased yield which may mean a little more labour but far greater profits. With regard to this, I think it is impossible to exaggerate the debt that the farmers of this country owe to the work which is being done here at Rothamsted and by Professor Biffen at Cambridge. I should like to say a special word about Professor Biffen because he is one of those extraordinarily modest people who can never be found except in their laboratory but who are really great benefactors of their country. He is not a mere scientist who deals with experiments in a test tube; he recognises that wheat growing has got to be made worth while if it is going to be pursued in this country, and he is devoting his great abilities to finding out how you can increase yields, particularly on the poorer lands. The services which he and his fellow-workers have rendered in this respect are amongst the most remarkable that have been given to the nation for many years past. He has produced for you rust-proof wheat which means a saving in many cases of from four to five bushels to the acre. He has now produced for you practical varieties of "strong" milling wheats which will compare with the best milling wheats from North America and which will, if grown, bring you an additional 3s. or 4s. a quarter. As a result of this work, of which you see little but which must mean much to you when you adopt these discoveries in your practical work, he is persuaded, and it has got to be proved that he is wrong, that it is by no means impossible that the average yield of wheat in this country can be brought up from four to five quarters per acre. If that is done you have practically solved the economic problem at once, and a good many of these difficulties about wages and other costs of production will disappear. Make no mistake about this: England, whether with regard to its soil, or its climate, or anything else, is probably the finest wheat-growing country in the world. We grumble at our weather; we grumble at our many difficulties, but they are nothing to what growers have to compete with in other countries. We do not make half enough use of our soil, and the present area under wheat must be increased in the national interest.

Control of Cultivation.—That brings me to another point with regard to which the critics are very severe. They object to that part of the Bill which deals with control of cultivation by the County Agricultural Committees. I sympathise with

what Lord Hampden said just now, not only with regard to agriculture but with regard to everything else in our national life. I also much dislike control. We have had a great deal of it during the War, necessarily, and we should all be glad in theory to get rid of it. (Hear, hear.) But when it comes to actual practice I do not always find that I get the same agreement. When I first went to the Ministry of Agriculture I tried very hard, as some of you know, to get rid of the control of home-grown meat, and I got a great deal of assistance in that direction from some farmers, but an even greater volume of opposition from other farmers. They said: "No, let us keep the control. We know where we are and we are not sure that we should get as good profits if it were taken off." It is not by any means always the case that farmers who call out loudly for the removal of control really want you to do it when it comes to some particular commodity in which they are interested. Let me take this as an illustration. If you had control taken off fertilisers to-day and we were not controlling the export of fertilisers so that they could not get a world market, the price of your sulphate would jump from £23 to £50 per ton. That is what the foreigner is willing to pay for it to-day. It is only by Government control, keeping the fertilisers in this country, that you are getting them at little more than one-half the average world price. So control sometimes has its merits! Let me say this with regard to the control of cultivation. The good farmer has absolutely nothing to fear from the measures of control which are contained in this Bill. There is no suggestion there, or possibility, of any great compulsory scheme of ploughing grass lands such as we had to engage in during the height of the submarine campaign. May I say with regard to that that I am the sinner who did it, and I will tell you why. I was in charge of the Food Production Department then and my instructions were perfectly plain. They were to produce more food, at any cost, in order that we should not run the risk of starvation and disaster in case the submarines succeeded in cutting us off. That was no time to consider "good husbandry" or to consider whether to plough this field or that field might do injury to a particular man. We did not pretend it was good husbandry; but we are not going to take that line now. We are in times of peace, thank goodness, and good husbandry is the thing we wish to consider before everything else. The powers we are taking in the Bill are those which are absolutely necessary in order to deal with bad farming. I venture to

say that the bad farmer is a curse to the industry. (Hear, hear.) He gets no sympathy whatsoever from the great majority who are farming properly. They recognise him as a danger to the industry and I hope he has got no friends. At any rate, we must reserve the right, in the last resort, to make him do his duty by the land and by the nation. And remember that a very large section of this Bill—one-half of the Bill—is devoted to giving increased security of tenure to farmers. But we do not want to give any increase of security of tenure to bad farmers. It would be a disastrous result of the land tenure part of the Bill if as a result the bad farmers, of whom I am sorry to say there are a certain number in this country, were fixed in their tenancy. That would not be in the national interest. (Hear, hear.)

Control and State Assistance.—Therefore the State must retain the right, in exchange for these special privileges which it is giving under the Bill, to insist that land shall be used to the best advantage—not in an uneconomical sense, but in the way of the best husbandry. There is no doubt about it, Parliament would never pass a Bill of this kind unless we coupled with the guarantees a reasonable measure of control. Certainly I am not prepared to work for guarantees and to get these special privileges unless the people who get them recognise at the same time their responsibilities to the nation. In this respect I say we must have the whole of the principles of the Bill or none. The Bill, of course, can be criticised and amended in detail; but the principles must stand and they must stand all together. They all form part of one coherent policy. Let me repeat with regard to those who are trying to stir up prejudice by saying that we contemplate some great compulsory ploughing campaign, that those fears are groundless. We are working on lines of achieving our object by inducement, not by force. We are doing it by making it worth the while of the farmer to increase his arable cultivation, with the addition that if it is made worth his while we feel he has no excuse to ignore the national need. In this matter public opinion is deeply interested. Public opinion is going to be brought to bear upon this industry through the Press and through the eyes of every consumer. You will not be able to ignore public opinion, and I have not the slightest reason to suppose that any of you wish to do so.

The Need for Confidence.—In the meantime we must do our utmost—I appeal to you all to do your utmost—to what I will call “stop the rot” with regard to lack of confidence

in arable farming. (Hear, hear.) There is, of course, resistance—positive resistance in some quarters—to any ploughing of grass land at all. I was sorry to see the other day that my friend, Lord Bledisloe, who is well known to all of you, completely misunderstood what our intention was with regard to this matter, and thought that under some clause of the Bill we were proposing to “destroy the fine green swards” throughout the west of England. Certainly nothing could be further from our intention. But we make no secret of the fact that we hope for, and expect, a large increase of wheat growing as a result of the provisions which we are making in this Bill. I believe we shall get it, and when we meet with the objection of people who say: “This grass land contains stored-up fertility; it would be unfair to the owner of the land if that stored-up fertility were used for the purposes of the tenant,” I have to say: “How long is it going to be stored up? How long is the talent to be wrapped in a napkin and kept in the ground?” If ever there was a time in the history of our country, now is the time for this fertility to be put into circulation. (Hear, hear.) We make ample provision in the Bill for full compensation to any landlord whose stored-up fertility is appropriated by a tenant, and who, perhaps, is leaving his holding. But we see no reason why the compensation should be more than the full loss actually suffered, and that is the meaning of Clause 16. At the other end of the scale we have got to consider the means of preventing an undue amount of seeding of arable land down to grass. Let me say at once that I recognise it is desirable that some land which was ploughed up during the War under the stress of the submarine campaign, and which proved to be unsuitable for corn growing, should be seeded down to grass. But in such cases we must insist that it should be done properly, and we must fight against a timid, retrograde, and unpatriotic policy of simply seeding down in order to avoid some of the difficulties—passing difficulties as I hope they are—with regard to labour and other matters.

Arable Farming and Improvement of Pastures.—Make no mistake about it, if a campaign of reducing our arable cultivation succeeded to any extent, if there was any general seeding down of arable land to grass, you would have in this country a counter-agitation for the nationalisation of the land—for taking away the land altogether from those who were doing this and for breaking it up and distributing it amongst smaller holders. I do not know whether you wish to see that, but

something must be done to check this, what I can only call, disastrous tendency to reduce the arable area in some districts. It is for that reason mainly that these powers to control cultivation are given to the County Agricultural Committees. They must have those powers, and I wish to make it quite clear that I intend, in so far as I have the power, and in so far as the Government have the power, to stick to this part of the Bill. But, concurrently, we see the importance of giving every assistance to the improving of existing grass lands. The Ministry has engaged in a very extended and important campaign with this object in view. I think many of you may have already seen something of it; but I should like to say how much you all owe to the devoted and unremunerated work which is being done in this connection by Professor Somerville, Professor Stapledon, Mr. Jenkin, Professor Gilchrist and others, who are devoting their time to going about the country assisting farmers with their advice and practical demonstrations.

The Food Outlook.—I only want to say by way of conclusion that I have been accused of "scaremongering" in connection with this Bill in order to try and assist its passage; that is to say, I have been charged with trying to frighten the people to believe that we may be short of food in this country when as a matter of fact there is no such fear. I hope there is no fear that we may have to go short; but at any rate I honestly believe—if I did not believe it I would not say it—that there is real cause for anxiety about the wheat supply of the world in the coming year and the years to follow. I know the evidence is very conflicting; I know the prospects are necessarily uncertain; I know there are many people interested one way or the other in giving this or that aspect of the facts. But my main contention is that there is not anybody who really *knows* what the food position is going to be in the world in the next twelve months. That being so, my policy at any rate, and I say the only sane and sound policy, is that we should take no avoidable risks. (Hear, hear.) It is quite true that I doubt, even with all the assistance that may be given to us by Rothamsted and the scientists, that we should ever be able to make ourselves fully self-supporting, in the ordinary sense, in this country. But I am quite clear from the experience of the War—and I am glad to see that Lord Ernle in his article to which I have just referred agrees with me—that we could without doubt grow enough food in this country, on our own soil, to enable us to support ourselves on a system of strict

war rations during any future war, and in that respect make ourselves safe against any development of the submarine campaign. Personally I shall never be satisfied—I shall never cease striving, whether in or out of office—until that moderate and prudent measure of national insurance and security has been attained. I am sure it can be done, and it is in the power of British farmers to do it. For that reason, and on this occasion, I make the most earnest appeal of which I am capable to them to respond generously. The Government in this Bill has endeavoured to play its part. We now ask the farmers of this country to play theirs. In doing so, not merely would they be doing what I believe is in the interests of themselves, in the interests of their labourers, and in the interest of the whole economic situation—but they will be rendering, as they have rendered more than once in the past, one of the greatest services that can be rendered by Englishmen to their country. (Loud applause.)

Mr. E. W. LANCFORD, J.P.—(President of the National Farmers' Union), also spoke, and said (in part):—

We have waited impatiently for the pronouncement of the Government as regards agriculture. We have the policy in the Bill. It does not go quite so far as some farmers of England expected it would go. It does not offer the panacea for all the difficulties with which we are confronted, and it does not solve all the problems with which we are confronted, but it is an honest endeavour to put into the Bill the pledges given in the Caxton Hall speech by the Premier.*

The nation is calling at this moment for an increased amount of arable land, and I hope every farmer will respond. If it is to be on a sound and profitable basis, and if it is possible for us to extract such crops and sell them at such price as to ensure a profit, I hope every farmer will do his best to carry out the main principles of the Bill to produce the increased foodstuffs of this country. To enable this to be done there must be absolute confidence in the mind of the farmer. The farmer is prepared when this confidence is given to him to do his level best with the land in this country.

I believe, if we stand firmly behind the Ministry, the Minister of Agriculture, realising, as he does, the importance of the food production of this country, will stand by the Bill, and it will be our turn when it becomes an Act of Parliament so to support him by increasing the food and land under the plough that the

* A report of this speech was published in this *Journal*, November, 1919, p. 772.

country will never have cause to turn upon him and say, " You led us wrong." The farmers should carry out the bargain if they are given this security. It is up to us to give all the support we humanly can. It is the best Bill that has ever been brought before the House of Commons in the industry in which we have been engaged. I hope it will come through the House without the main principles being interfered with. Then we will go forward to produce the foodstuffs so essential to the well-being of the country.

MORE WHEAT.

SIR DANIEL HALL, K.C.B., F.R.S.

FEW questions are of more importance, not merely to the farmer but to the whole community, than the prospects for the production and price of wheat during the next year or two.

Production and Imports, 1909-13 and 1918.—In order to understand the situation we may begin by comparing the production and imports in the years immediately preceding the War with those in 1918.

Wheat Imports.

Average 1909-13.			1918.		
	Cwt.	Per cent.	Cwt.	Per cent.	
Home Production .. }	31,950,246	21·3 ..	49,899,000	34·5	
United Kingdom .. }					
Canada	24,678,948	15·1 ..	23,697,450	16·4	
Australia	12,423,203	8·3 ..	4,345,783	3·0	
India	19,393,056	12·9 ..	719,594	0·5	
U.S.A.	26,336,680	17·6 ..	49,706,360	34·4	
Russia	15,788,123	10·5 ..	—	—	
Argentine	16,848,870	11·2 ..	14,391,067	10·0	
Other Countries ..	4,640,716	3·1 ..	1,697,912	1·2	
Total Imports ..	118,109,596	78·7 ..	94,558,166	65·5	
Total	150,059,842	100·0 ..	144,457,166	100·0	

In 1918 we had, perforce, reduced our consumption from 150,000,000 cwt. to 144,000,000 cwt. Home production had been stimulated from an average of under 32,000,000 cwt. to nearly 50,000,000 cwt., so that it formed 34½ per cent. instead of 21 per cent. of the consumption. Shipping difficulties had almost wiped out the imports from Australia and India, Russia was no longer an exporter, and the quantity obtained from the Argentine was somewhat reduced, but the United States came forward with nearly 50,000,000 cwt. instead of 26,000,000 cwt. in the pre-war years.

Nineteen hundred and nineteen saw the British production drop from 49,899,000 to 37,135,714 cwt., but the United States and Canada sent 71,613,142 cwt., and Australia again made a substantial contribution. What are the prospects for 1920?

Prospects for 1920 and 1921.—For the cereal year 1919-20 the imports into this country will be about 100,000,000 cwt., and the requirements for 1920-21 may be set at a rather higher figure, say 110,000,000 cwt., in view of the unascertained but still certain decline in the acreage sown with wheat in the United Kingdom for the 1920 crop.

The acreage sown with wheat in America, from which the main export to Europe is derived, shows a considerable decline, something like 25 per cent.* Against this there is estimated to be a carry over of something more than 60,000,000 cwt. from the 1918-19 crop.

India has a good crop and an exportable surplus, and Argentina has also an exportable surplus from its 1920 crop, though there are doubts whether Europe can get it.

Australia has no longer any accumulated surplus, and with the bad season it has just been going through the prospects of export from its crop of 1921 are very problematical, while export from Russia cannot on the evidence before us be expected.

In any case, after taking into account the North American carry over, there is a very narrow margin for safety, and there are two factors in the question that cannot be estimated. There is the demand from France, Italy and Belgium, which in 1918-19 amounted to something more than 110,000,000 cwt., and the entirely unknown demand, unknown both as to extent and the financial capacities of the countries to pay for it, from Central Europe, where, however, good crops are expected. Again, the non-European countries, particularly Japan, are becoming greatly increased wheat eaters, and will cause an additional strain upon the world's supply.

There is no department in which prophecy is more dangerous than that of food supply, but in view of the fact that under the most favourable view the world will only get through the year 1920-21 in virtue of the American surplus, and that every civilised country shows the same phenomenon of a withdrawal of labour from the land, we cannot escape from the conclusion that wheat will be short in the world for some years to come—so short that any bad crop in one of the great producing countries may result in something like famine conditions.

* *Wheat Acreage.*

				1919.			1920.
U.S.A.	{ Winter	..	..	49,905,000	..	38,770,000
	{ Spring	..	..	23,338,000	..	19,487,000
				73,243,000	..	58,257,000	
Canada	..	..	..	19,126,000	..	17,000,000

for an increased Arable Area.—The nation is in urgent need of an increased acreage of land under the plough in order to provide the greater production of food which is possible on the arable land as compared with grass. In more normal times it is not necessary that a large proportion of that arable land shall be cropped with wheat, although on ordinary soils wheat must always be a considerable item in the rotation. The farmer will naturally grow the crops which happen to pay best under the existing market conditions. The essential feature is that the land shall be under the plough and so producing on the higher level; and, again, always ready to turn over to wheat should the emergency arise. That emergency is, however, in being for the next few years.

As we have seen, the wheat production of the world is short and the people must be fed. In consequence, for the next few years wheat is likely to pay as well as any other general crop, and it is to the interests of the farmer as well as the community to set about an immediate increase in the wheat acreage.

It is a common argument that the acreage under wheat in this country has more than reached its paying limit, that in 1914, or thereabouts, all the land fit for wheat was carrying that crop in the rotation, and that the remaining land was of a class from which only an indifferent and unprofitable crop could be expected, 3 instead of 4 quarter land. This idea, however, that the bulk of the land in this country is unfit for the growing of wheat, is not borne out by the past history of agriculture. The acreage under wheat in 1869, the highest year for which exact records exist, was 3,969,000; it had fallen to 1,905,000 in 1914, rose again to 2,793,049 in 1918, but fell to 2,370,367 in 1919, from which figure a further reduction may be expected in the current year.

Land on which the Wheat Area has declined since 1872.—Let us examine the classes of land on which the shrinkage of acreage since 1872 has chiefly taken place. In the first place it is notorious that the very heavy clays in the south and east of England, upon which good crops were grown before the great depression, have very largely been laid or tumbled down to grass because the heavy costs for labour involved in keeping such land under the plough could not be paid for at the low prices which prevailed for arable produce during the 'eighties and nineties of last century. Some of this land was compulsorily ploughed up during the War, but is now reverting to grass, so much are farmers apprehensive of the great rise in the cost

of labour. Many farmers, however, in such districts as, for example, Essex, have learnt how to handle such land with success and are still extensive wheat growers.

Secondly, there is the very large area of indifferent clay land over the Midlands, not nearly so heavy and intractable as the clays of Essex and the eastern counties, but which still has been lost to the plough during the last forty years. Over this area labour is very short, and even where arable farming is still practised the cultivation is indifferent and the soil is habitually worked to a very shallow depth.

There are, again, the large tracts of lighter lands, as, for example, upon the chalk loams themselves, where arable farming has largely given place to dairying. Though this land is eminently suited to the plough, and though it does not carry first-rate grass, it has been laid down because of the better returns that accrued from grass farming and dairying in the years immediately before the War.

Lastly, there exist many of the lighter lands which, though still ploughed, are regarded as unsuitable to wheat, and did not yield large enough crops to pay at pre-war prices.

On all these classes of land wheat may be greatly and profitably extended by taking full advantage of the recent developments in mechanical cultivation, the proper use of manures and the planting of reliable seeds.

Wheat not exacting as regards soil, climate, etc.—What one has to remember is that so far from it being necessary to reserve only the best soils for wheat, the wheat crop is really one of the least exacting of all as regards climate and soil. Again, it can be made one of the cheapest of all crops to cultivate. We have only to turn to the examples afforded by new countries to see the truth of these statements, for there we find wheat not only cultivated under the most diverse conditions, but regularly employed as the first crop wherewith to break in the wilderness. Other and more delicate crops may follow, but in the first years the produce is often confined to wheat.

Furthermore, practically the whole of the operations connected with wheat growing can be performed wholesale by mechanical power, from the preparation of the soil, seeding and manuring on to harvest. The most typical example is afforded by the single-handed Australian farmers in their wheat areas; they regularly plough, sow and harvest 120 acres or more without any assistance, and at the same time cultivate the bare fallow which is to be the preparation for the next year's

crop. No one wants to grow wheat in this country in that fashion, nor does one need to do so, but it does show how susceptible the crop is to labour-saving devices.

Conditions for growing Wheat on inferior Land.—If a payable crop of wheat is to be ensured upon the inferior land of this country certain essential conditions must be observed; they hold, of course, for all wheat growing, even though they may to some extent be neglected on the best wheat soils where conditions are so favourable as to make up for the set-backs the plant may suffer.

Early Sowing.—In the first place we put an early start. On the heavier, colder and higher soils we can only expect a good wheat crop if it is sown before the end of October, and the early part of that month or the end of September are better still. The early start makes much more sure of the establishment of a plant that will stand the winter, germination is better and the plant gets its roots down before the soil becomes waterlogged. This, again, makes to some extent for early and even ripening; above all it helps the plant to stand up as harvest approaches. Of course, on the best land early sowing may result in the wheat becoming "winter proud," but thin seeding obviates damage from that cause.

Manuring.—The next point to be considered is that for wheat growing on the poorer land some corrective manuring is generally necessary. Wheat is often regarded as a crop that requires no special manuring beyond the residues that remain from the manures applied during the rotation, and perhaps a dressing of sulphate of ammonia or some other nitrogenous fertiliser in the early spring, which greatly benefits the yield; but on the heavier and colder soils it is, perhaps, more necessary to apply a dressing of basic slag before the crop is sown. This promotes earlier ripening and better root development, and also helps the crop to stand up. On the very lightest soils, again, wheat cannot be profitably grown without some potash manure.

Good Seed.—Thirdly, it is difficult to exaggerate the importance of good seed. There are several of the newer varieties, among which we may instance Yeoman, Little Joss, Svalöf Square Head, and Swedish Iron, which can be counted upon to give two or three more bushels per acre than the old varieties. It is unsafe to specify a particular variety—Little Joss, for example, does not answer well on land which lies wet and cold during the winter—but the local Agricultural College or Farm Institute can generally advise as to the best cropping wheat for the particular locality.

Quick Harvesting.—The last point on which we may insist is the necessity for ample power and some degree of hustle at the harvesting. There are seasons, like 1918 proved in the north and west, when the weather is uniformly adverse, but in most years the determined farmer can get his wheat safely stacked in good condition if he takes full advantage of the intervals of fine weather that are granted to him. It is here, as with early sowing, that the tractor can be made so useful. Again, wheat can safely be cut a little earlier than is the custom without the danger of the loss of quality that, for example, attends the premature cutting of barley.

Special Cases.—Heavy Clay.—Returning now to special cases, that have been enumerated above, on the heavy clay lands the preparation either of old grass land or temporary leys should begin at once with a deep steam ploughing as soon as the hay crop has been secured. Unless conditions are favourable it is generally necessary to do this first preparation of land with steam or with one of the heavier types of tractor, because either with horses or the lighter tractors it is difficult to make the plough hold the ground. When the land is still too hard to plough a cultivator may be used. What is wanted is to get the land turned over and the clods baked through with the sun. As soon as the soil is dried out and a considerable proportion of the grass has been killed, a second cross cultivation should follow, and here, again, it is generally necessary to use steam or the tractor, as horses find it difficult to work on the rough clods. With any sort of luck in the way of weather, a third cultivation ought to leave the land ready for sowing at the end of September or early in October.

The use of wide drills, harrows and rollers drawn by mechanical power is necessary if the costs are to be properly kept down. As has already been mentioned, basic slag should be sown before or with the seed. Machines have been devised which combine a clod crusher with a seed and manure drill, and to which harrows can be attached, so that the whole of the latter operations can be completed at a single stroke. It is to the extended use of machines of this type that the farmer must look for rendering wheat growing, and indeed the cultivation of any cereal, profitable.

Lighter Land.—The same considerations apply to the second class of land, the rather lighter class in the Midlands, but where these have been habitually worked only to a very shallow depth of 4 or 5 in. it may not be wise to plough so deeply at first. It is essential to break up the pan which long continued

shallow cultivation has produced on these soils, but to go down to a depth of 10 in. or more runs the risk of bringing up too much infertile subsoil, and the deepening of the tilth should be done more slowly. On most of this land, if it is not baked too hard, any kind of tractor can be used for breaking up.

Other Land.—The third class is any farmer's land, and does not require such special care in its cultivation. None the less a better wheat crop will result if the land is broken up early, in time to take a half fallow, than if it is held back for autumn cultivation and later sowing of wheat. On the lighter sands the success of the wheat crop depends upon manuring. Five cwt. of basic slag must be sown, together with 3 or 4 cwt. of potash manure, and a spring dressing of sulphate of ammonia, or, better still, of nitrate of soda, must follow. The extra expense of manuring on this land is made up for by the cheapness of cultivation. Early sowing is again essential, because it is necessary to establish the wheat with a deep root system before the droughts set in in the spring. Such land, because of its early ripening powers, will grow spring wheat, but success depends upon luck in the matter of weather, and very often spring-sown crops will fail because the absence of rain in the early part of the year does not enable the plant to establish a root system which will render the crop independent of the droughts that are sure to affect the surface later. On this class of land, again, rolling, in order to consolidate the soil and make the most of the lower moisture, is all-important.

Cost of Wheat Growing.—The cost of production is so entirely determined by local conditions, the equipment of the farmer, and the weather experienced in the particular season, that any estimate based upon averages is of little service to the individual, particularly as the returns both as to yield and price are equally matters of speculation.

Of late years, however, on second-class land wheat has generally proved to be the most paying crop upon the farm, and having regard to the considerations urged above as to the prospective shortage of supply all the world over it can hardly fail to be a profitable speculation for some years to come, even at present costs of labour.

On second-class land the farmer must exercise greater care and adopt the precautions which have been indicated in order to secure a reasonable yield. Moreover, whether it is for wheat or any other crops, the farmer has got to consider in every possible way how the costs can be reduced by the

adoption of large-scale methods of production—big fields, tractors or steam, wide implements, etc. This may involve some initial capital outlay, but farming in the future is not going to be successful without such outlay and a determination to take advantage of all recently-developed resources in the way of labour-saving machinery and improved methods.

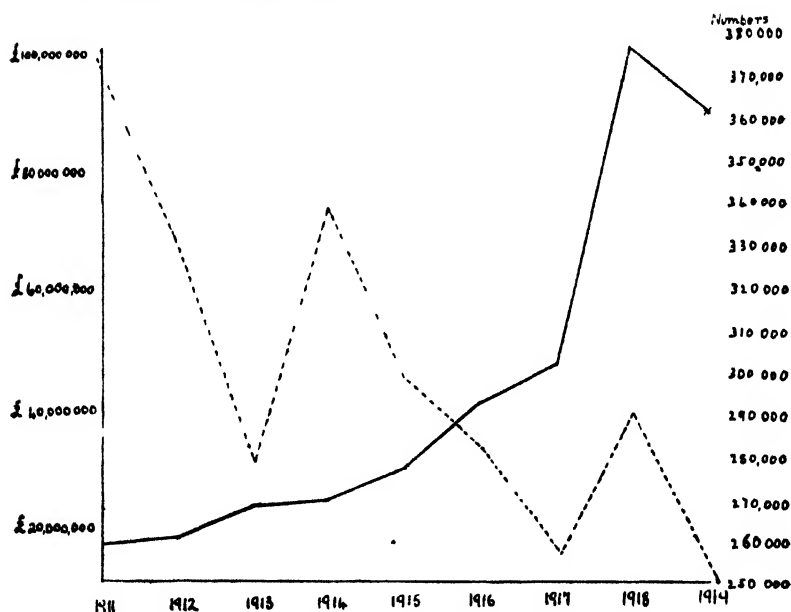
The world is in serious need of wheat, and over a much greater acreage than is now devoted to the crop the British farmer is as well placed as any others to meet that need at a profit to himself.

PIG FEEDING AND THE COST OF PORK PRODUCTION.

ARTHUR G. RUSTON, B.A., D.Sc. (London), D.Sc. (Leeds),

Lecturer in Farm Economics, the University, Leeds.

It may seem strange that at the present time, when bacon is commanding such a high price in the market and the value of imports has so largely increased, there should be a decline in the number of pigs, especially of breeding sows, kept in England and Wales. The total value of the ham, bacon and pork imported into the United Kingdom has increased from just over £18,800,000 in 1911 to more than £90,000,000 in 1919, yet during the corresponding period the total number of pigs in England and Wales has declined from 2,651,039 to 1,798,468, a decrease of 32 per cent.



Graph showing (1) The Value of Pig Meat imported annually into the United Kingdom, 1911-19 (black line); (2) The Number of Breeding Sows in England and Wales, 1911-19 (dotted line).

During the same years the number of breeding sows in England and Wales fell from 375,583 in 1911 to 250,752 in 1919, a decrease of more than 33 per cent. While there was a very marked fall in the number of breeding sows kept in 1912 and in 1913, a partial recovery occurred in 1914, after which the reduction in numbers, owing to the influence of the War, is

most marked. The great reduction in the number of pigs kept from 1915 onwards can most probably be accounted for (1) by the increasing difficulty in securing supplies of food for them, and (2) by the widely prevalent idea that the high prices of pig meal and millers' offals made the production of pork economically unsound. In spite of the high prices for the raw material in the manufacture of pork, the writer has found in nearly all the cases investigated by him that the keeping of pigs, even in the later years of the War, could be made and was actually made a very profitable business. Now that feeding stuffs are more readily obtainable, and prices have fallen, it is to be hoped that full advantage will be taken of the improved situation, and that our output of pork, bacon and ham will be increased, so that we may be able more nearly to satisfy our own demands and to diminish imports. When the control price of pork was raised from 21s. to 23s. per live weight score, any doubts as to making a commercial success of a well-managed herd of pigs must have been set at rest.

Pigs on a Yorkshire Farm.—In these circumstances it was thought that the actual detailed records of the receipts and expenditure in connection with the management of pigs on a Yorkshire farm of just over 300 acres, during the year 1st April, 1918, to 30th March, 1919, might be of interest. The Department of Agriculture of Leeds University has for some time past been engaged in investigations into the cost of production of milk, pork, beef, mutton, crops and other farm products on a number of farms throughout the county, including its own experimental farm at Garforth. On these farms detailed valuations of the live and dead stock are made at the beginning and end of each financial year, either by a professional valuer or by a member of the staff of the Department of Agriculture in conjunction with the farmer himself.

On the farm in question, the 73 pigs in stock on 1st April, 1918, were valued by a professional valuer at £341. This number included 1 boar, 20 breeding sows and gilts, 21 stores and young gilts, and 31 sucking pigs. On 30th March, 1919, there were on the farm 1 boar, 22 breeding sows and gilts, 4 fattening pigs, 30 stores and young gilts, and 4 sucking pigs. These were valued by the same valuer at £614.

Records of all the farms under investigation are kept in a detailed Cash Book, showing receipts and expenditure in connection with the stock. These records showed that on the farm in question 92 pigs were sold during the year for a gross return of £911 3s. 8d. Arrangements have been made for the whole

of the stock on the farm to be weighed at the beginning and end of the financial year. In addition, any stock bought during the year is weighed at the time of purchase, and any stock sold is again weighed at the time of its sale. Under this system it is possible to ascertain the total live weight of pork, beef or mutton produced on the farm each year, and, if necessary, to calculate the rate of increase of each individual animal.

The weight of pigs produced during the year was :—

	cwt.	qr.
Weight of 92 pigs sold during the year	160	3
61 pigs on the farm on 30th March, 1919, weighed on that date	96	0
	<hr/>	
	256	3
73 pigs originally in stock, weighed on 1st April, 1918	55	2
Produced during the year	<hr/>	
	201 cwt. 1 qr.	

Time sheets and detailed records are kept of the daily labour of each man, horse or tractor on the farm, so that at the end of each week it is possible to apportion to each crop or kind of stock its proper share of the labour bill.

The weekly or fortnightly wages sheet is so designed as to include not only the cash wages actually paid, but also the monetary equivalent of that part of the wages paid in kind.

In addition, the Stock Book is balanced monthly, so that accurate information may be readily available as to the number of the various heads of stocks on the farms at any particular time.

Cost of Labour.—From the Daily Labour Sheets, Wage Book and Stock Book, information was collected from which it was shown that 254 days' man labour at a cost of £62 15s. 11d. and 15 days' work for a horse at a cost of £2 19s. 8d. had been utilised in attendance on the pigs, the total labour bill for which amounted during the year to £65 15s. 7d.

The cost of attendance per pig per week varied from 2½d. per head in July to 6½d. per head in March, with an average of just under 4d. per head per week throughout the whole year. This cost, however, only holds good when on the average one man is fully employed in looking after 124 pigs, and receives an average daily wage of 4s. 11½d., and when the average cost of horse labour is 4s. per day. The average daily cost of human labour in attendance on the pigs, viz., 4s. 11½d. has been arrived at by dividing the total cost of the labour, viz., £62 15s. 11d., by the total number of days' labour expended.

viz., 254. The resulting figure is low, mainly because most of the labour in attendance on the pigs was performed by women. If, as is probable, there has been an increase of 50 per cent. in the price of daily labour in respect of the year 1919-20, and the attendant still does the same amount of work, the cost of attendance per pig per week on that particular farm for the current year will probably amount to 6d. per head per week instead of 4d., as during the period under notice.

The estimated cost of attendance per pig per week during November, 1919, worked out in respect of six farms, was as follows :—

On Farm A at 5d. per head per week.

..	B ..	5½d.	..	..
..	C ..	6d.	..	..
..	D ..	6½d.	..	..
..	E ..	6½d.	..	..
..	F ..	7d.	..	..

Cost of Feed.—Little difficulty has been experienced in checking the amount and cost of the purchased foods consumed by the various kinds of stock.

Rations are drawn up for all the stock, alterations are noted as they are made, and the amounts of the various foodstuffs consumed are apportioned monthly to the stock consuming them. The actual amounts consumed are checked with the estimated amounts according to the rations drawn up. This is done by making an inventory each month of the various foods still left unconsumed on the farm, and deducting the amount left over at the end of the month from the quantity in stock at the beginning, plus the amount purchased during the month.

The actual consumption never quite agrees, nor, in fact, can it be expected to agree, with the estimated consumption; but the one ensures the accuracy of the actual amount consumed, and the other enables one with as great a degree of accuracy as possible to apportion the amounts so consumed among the different kinds of stock. The purchased foods so consumed are charged to the stock at their actual cost price, including the cost of carting to the farm.

The home-grown foods, on the other hand, have all been charged at prices corresponding to their actual cost of production. These prices have in all cases been worked out as carefully as practicable.

Thus, the cost of growing 7½ acres of potatoes on newly-ploughed grass land was found to be £235 os. 4d.; and the whole cost of growing 11½ acres of potatoes on the farm

amounted to £355 6s. 9d., corresponding to £30 4s. 10d. per acre. The total yield was 111 tons, and the cost of production in respect of the 11½ acres, therefore, works out at £3 4s. per ton. Of the 111 tons produced, 76 tons were sold, and 5 tons were retained for seed; the remaining 30 tons represent what was fed to the pigs, and the unavoidable waste. The whole 30 tons were charged to the pigs at the cost price of £96 (*i.e.*, £3 4s. per ton).

Just over 11½ acres were under swedes, and lifted at approximately 21 tons to the acre. Rather less than a third of these were eaten by the sheep; a few went to the pigs and horses, and the remainder were consumed in fairly even proportions by the cows and other stock.

From this information, distribution of the total cost of growing the crop, *viz.*, £233 7s. 4d., was made in the following proportions:—£73 were charged respectively to the sheep, cows and bullocks, heifers and calves; £7 to horses; and £7 7s. 4d. to pigs.

Two and three-quarter acres were under mangolds, and the cost of growing the crop amounted to £58 17s. 5d. Of this amount £15 15s. was charged separately to the sheep, to the cows, and to the stock, £5 6s. to the horses, and £6 6s. 5d. to the pigs.

Four acres of peas were grown at a total cost of £38, but, owing to the prolonged rains of August and September, the crop was left out for at least six weeks after cutting, and consequently was harvested in extremely bad condition. No part of the crop was fit for sale, and it was, therefore, fed to the cows, bullocks, and pigs; £6 was considered the proportionate share of the total cost which should be charged to the pigs.

Thirty-nine and a half acres of oats were grown, yielding a crop of 315 qr., at a cost of £546 18s. 6d., of which sum £478 10s. 10d. was allocated to the grain and £68 7s. 6d. to the straw. The cost per qr. of the oats harvested works out at £1 10s. 6d., and the 51 tons of oat straw obtained were grown at a cost of £1 5s. a ton. Thirteen qr. or approximately 2 tons of oats were consumed by the pigs, and were charged to them at £20.

As the farm in question was approximately half arable and half grass, half of the salary of the farm manager, the wages of the farm mechanic, and of the various incidental expenses which could not otherwise be allocated, were charged to the arable land, and the remaining half charged to the stock in

proportion to the average capital value of these at the beginning and end of the financial year. The amount debited to the pigs for management and incidental expenses amounted to £60 11s.

Cost of Rent and Rates.—In addition to this, each class of stock has been charged its fair share of the rent and rates of the buildings used by them. Thus, of the £453 12s. 6d. actually paid for the rent of the farm, £20 has been charged to the horses, £25 to the cows, £30 to the bullocks, heifers and calves, and £18 to the pigs for the use of the building; the remainder has been distributed evenly over the grass and arable land at a rate which works out at £1 3s. 2d. per acre. Distributing the rates in the same way, the amount charged to the pigs as their share of the rates and taxes was £3 12s.

Profit and Loss Account.—A Profit and Loss Account for the year in which the pigs are debited with all the expenses incurred in respect of their keep, and credited with their valuation at the end of the financial year, the receipts from the sales during the year, and the manurial value of foodstuffs consumed by them, would show for the year a net profit of £414 19s. 5d. On the total capital outlay of £1,173 9s. 8d., the percentage profit would therefore be 35½ per cent.

The accounts kept on the above system show much more than the actual profits made by the pigs during the year. It is stated on p. 342 that the live-weight increase for the year was 201 cwt. 1 qr. The cost of producing this quantity is shown in the balance sheet to be £832 9s. 8d., so that the cost of production of the pork has been on an average £4 2s. 8d. per live-weight cwt., or 14s. 9d. per live-weight score. If the actual cost of keeping the pigs throughout the year amounted to £832 9s. 8d., and the average number of pigs on the farm throughout the year was 82 (see p. 342), the average cost of keeping a pig for one year would have been £10 3s. 1d.; or 3s. 11d. per pig per week. Of this 3s. 11d. the food bill absorbs 3s. 2d., and the labour bill 4d., leaving 5d. per pig per week for the various incidental expenses.

Information is available from the records which will enable a fairly accurate check to be made of the valuation of the professional valuer of the pigs in stock at the beginning and end of the financial year.

The 73 pigs in stock on the 1st April, 1918, weighed 55 cwt. 2 qr., and were valued at £341, equivalent to £6 3s. per live-weight cwt., or £1 1s. 11d. per live-weight score.

Dr.

PIG ACCOUNT, 1918-19.

Cr.

To Valuation of 73 pigs, 1st April, 1918				By Valuation of 61 pigs, 30th March, 1919			
..	£	s.	d.	..	£	s.	d.
Labour .. .. .	..	341	0 0	" Sale of 92 pigs during year .. .. .	..	614	0 0
Rent and rates of buildings .. .. .	..	65	15 7	" <i>Manurial value of foods consumed—</i>	..	911	3 8
Management charges .. .. .	..	21	12 0	19½ tons of pig meal .. .. .	..	32	0 0
Repairs and incidental expenses .. .. .	..	13	5 0	2½ " fish meal .. .. .	..	12	12 0
Purchased foods—	£	s.	d.	1 " sharps .. .. .	..	1	17 7
19 tons 10 cwt. pig meal	360	10 0		1 " bran .. .. .	..	0	9 5
2 tons 4 cwt. fish meal	45	1 0		6½ " margolds .. .. .	..	1	9 3
1 ton sharps	13	13 0		6½ " swedes .. .. .	..	1	2 9
5 cwt. bran	3	5 0		1 " peas .. .. .	..	0	11 3
Home-produced foods—	431	9 0		30 " potatoes .. .. .	..	9	0 0
1 acre mangolds	6	6 5		2 " oats .. .. .	..	2	3 6
1 acre swedes	7	7 4		2 " barley .. .. .	..	1	19 8
1 acre peas	6	0 0		14½ " separated milk .. .. .	..	..	..
30 tons potatoes	96	0 0		22½ " whey .. .. .	..	..	..
13 qr. oats	20	0 0					
10 qr. barley	18	0 0					
3,272 gal. separated milk at 5d.	68	3 4					
5,000 gal. butter milk and whey	31	5 0					
PROFIT .. .. .	..	253	2 1				
	..	414	19 5				
		£1,588	9 1				

The 61 pigs in stock on the 30th March, 1919, weighed at that time 96 cwt., and were valued at £614, which would represent £6 8s. per live-weight cwt., or £1 3s. per live-weight score.

The total weight of the 92 pigs sold during the year amounted to 160 cwt. 3 qr., and the total receipts from these sales £911 3s. 8d., an equivalent of £5 14s. per live-weight cwt., or £1 os. 6d. per live-weight score. It would certainly seem as if the values of the pigs in stock, particularly at the end of the year, were over-estimated rather than under-estimated, and that approximately £20 might be struck off the net profits arrived at, as allowance in respect of possible inflated valuations.

Grain per lb. of Live Weight Increase.—Information is also available which will enable a check to be made in one or two ways as to the suitability or otherwise of the feeding of the pigs. Converting the foods consumed by the pigs into their equivalents of barley, according to the Danish standards, it can be shown that the pigs have consumed during the year the equivalent of 661 cwt. of barley, and in return for that food have put on a live-weight increase of over 201 cwt. If the pigs have put on weight at the rate of 1 lb. for the equivalent of every 3½ lb. of barley fed, there can hardly be anything radically wrong with the method of feeding adopted.

Incidentally, the accounts bring out the great efficiency of the pig as a machine for converting food into flesh, and its great superiority in this respect over any other class of stock. While on the farm in question the pigs put on 1 lb. of live-weight increase for the equivalent of every 3½ lb. of barley fed, the bullocks on the same farm only put on 1 lb. of flesh for the equivalent of every 7 lb. of barley fed. As the carcasses of the pigs have been on an average approximately 78 per cent. of the live weight, and of the bullocks approximately 54 per cent., the pigs have produced *one pound of pork for every 4.2 lb. of barley fed*, whereas the bullocks have produced only *one pound of beef for every 13 lb. of barley fed*. It follows, therefore, that the efficiency of the pig as a machine for the production of human food in the form of meat is more than *three times greater* than that of the bullock; a point which of itself is a very strong argument for the rearing of more pigs on farms at the present time.

Cost of Foods used.—While, however, as has already been pointed out, there was nothing very radically wrong with the method of feeding the pigs on the farm in question, it does not follow that the best or most economical method had been adopted. The purchased foodstuffs consumed during the year

by the pigs were equivalent in feeding value to 335 cwt. of barley, and were fed at a cost of £431 9s. They would, therefore, correspond to barley fed at £1 5s. 6d. per cwt. or £5 1s. per qr.

On the other hand, the home-grown foods consumed by the pigs during the year were equivalent in feeding value to 258 cwt. of barley, and these were produced at a cost of £153 13s. 9d.

They would, therefore, correspond to barley fed at 11s. 7d. per cwt., or £2 6s. 4d. per qr.

It is evident, therefore, that if pork is to be produced on the most economical basis, as large an amount as possible of home-grown foods should be available to feed them.

These figures also furnish data from which milk products such as separated milk and whey fed to the pigs on the farm may be valued. The 3,272 gal. of separated milk fed have approximately the same feeding value as 31 cwt. of barley. If the barley is valued at £1 5s. 6d. per cwt., the price at which the barley equivalents in the purchased feeding stuffs were purchased at the current rates, it means that the 3,272 gal. were worth roughly £39, and that the separated milk should be charged at 3d. per gal. for feeding purposes. Similarly, the 5,000 gal. of whey fed to the pigs have about the same feeding value as 36 cwt. of barley, and would, therefore, be worth approximately £45, or 2d. per gal. for feeding purposes.

Feeding Standards.—It is interesting, also, to note how closely the average ration fed to the pigs during the year adhered to the standards suggested by Kellner, and generally accepted both in England and Germany.

As the average weight of the 92 pigs sold during the year was 196 lb., of the 61 pigs in stock at the beginning of the year 100 lb., and the 73 pigs in stock at the end of the year 148 lb., it is most probable that the average live weight per pig on the farm throughout the whole year would be approximately 150 lb.

The daily ration, therefore, if it fitted in with Kellner's standards, should be such as to include approximately :—

30 lb. of dry matter	} per 1,000 lb. live weight per day.
2½ lb.—3 lb. of protein ..	..
21 lb. of starch equivalent ..	..

The total amount of dry matter fed during the year was 412.4 cwt., and of digestible protein 108.7 cwt. The starch equivalent of the dry matter fed was 494.6 cwt., from which it follows that the average daily ration fed to the pigs throughout the year actually contained—

26 lb. of dry matter per 1,000 lb. live weight per day instead of 30 lb. suggested by Kellner.

4 lb. of digestible protein per 1,000 lb. live weight per day instead of 3 lb. suggested by Kellner.

19 lb. of digestible starch equivalent per 1,000 lb. live weight per day instead of 21 lb. suggested by Kellner.

The daily ration, therefore, was slightly in excess of the requirements, so far as the digestible protein was concerned, and slightly below the standard so far as the carbohydrates were concerned. If 4 acres of grass, at a cost, approximately, of £10, and the produce from 1½ acres of vetches, at a cost, approximately, of £12, had been placed at the disposal of the pigs, it is very probable that a saving of at least 3 tons of meal at £20 per ton might have been effected without in any way reducing the live weight increase of the pigs.

Conclusions.—In conclusion, the writer would wish to emphasise the importance of increasing our stocks of pigs on farms, and doing all that is possible to encourage the breeding and rearing of pigs. Such increase is desirable—

- (1) in order that we may to a large extent supply our own demand for bacon and ham and reduce to a normal figure our excessive imports of these commodities;
- (2) because there is no doubt that the pig is the most efficient machine for the production of human food in the form of meat;
- (3) because, especially, now that the prices of pig meal and millers' offals are showing signs of falling, the breeding and rearing of pigs should be economically sound and certainly remunerative;
- (4) in view of the importance of increasing, to as large an extent as possible, the production of cheap home-grown foods, and especially of making use of grass feeding, if the pork is to be produced on the most economical basis.

POULTRY KEEPING IN FRUIT PLANTATIONS.

G. H. GARRAD, N.D.A.,

Agricultural Organiser for Kent.

POULTRY keeping and fruit growing is an excellent combination. The poultry help the fruit trees by manuring the soil, and if the land has previously been under cultivation the birds will, by their scratching, keep it almost entirely free of weeds and reduce much of the expense of keeping the land cultivated. Moreover, they will consume innumerable caterpillars and other enemies of the fruit grower, and for a pest like the pear midge, the maggot of which falls out of the fruit to pupate in the ground, the keeping of poultry is the only practicable remedy.

This method of keeping poultry is also economical from the fowls' point of view, for they occupy ground beneath the fruit trees that would otherwise in many cases be unused, and they feed to a large extent on insects that are normally regarded as pests. They may occasionally do some damage to bush fruit and cob nuts by picking out some of the buds from the low branches, but this is not serious, provided that the birds are sufficiently fed. Heavy breeds of fowl like the Buff Orpington do less damage than the lighter breeds, because they do not climb so high into the trees.

The primary object of this article is to show that poultry keeping and fruit growing can be made a very profitable combination. During the past five years the writer has carefully checked the accounts of a small holder in one of the fruit-growing districts of Kent, Mr. W. Hall, of Grover Hill, West Peckham, near Maidstone. Mr. Hall and his son occupy 20 acres of land on the lower Greensand Formation, on the face of a steep hill facing the south, an ideal situation for poultry. His land is cropped as follows :—

7½ acres standard apples, interplanted with cob nuts.

3½ „ half-standard plums and damsons, interplanted with gooseberries.

3½ „ half-standard apples, interplanted with gooseberries and cob nuts.

1 „ arable land.

4½ „ grass land.

The poultry are confined in permanent runs in the 14½ acres of fruit. At first it was the practice to dig the land over once a year, and the fowls then kept it well worked for the rest of the

season, but some of the ground has not been dug for two seasons, and there is not a weed visible on it. The birds' constant scratching keeps a tilth of fine soil on the surface, which doubtless is beneficial in keeping the moisture in the ground. Mr. Hall does not believe in deep digging, because it prevents the fine feeding roots of the trees from working their way close up to the surface of the ground where they can make full use of the manure from the poultry; he therefore only digs sufficiently deeply to enable the hoe to work afterwards. He also prefers a shallow tilth, because the caterpillars that fall from the fruit trees are then unable to bury themselves deeply in the soil, and are quickly consumed by the poultry. In years when there have been bad attacks of winter moth caterpillars among the nut bushes, he has made a practice of walking through the plantation and shaking each bush. The poultry follow and consume each caterpillar as it falls to the ground! Only young chickens are allowed to run among the gooseberry bushes, the hens being confined in coops; but hens if properly fed will not attack gooseberries (nor currants) until they begin to colour, and do a great amount of good by picking off the scale insects that are frequently so numerous on the stems of gooseberry bushes. Poultry are invaluable in dealing with the raspberry and loganberry beetle, but they will not attack the hairy sawfly caterpillars that often do so much damage to gooseberry bushes; only cuckoos will deal with these. The hens do not roost in the apple and plum trees, and do very little harm among the nut bushes, provided that the birds are not too closely penned. Mr. Hall allows his nut bushes to grow rather taller than his neighbours' bushes, but succeeds in growing quite as large a crop of nuts. Many of the nuts are not gathered until they fall to the ground, and the birds do not usually attack them, but once the birds have tasted the nuts it is impossible to prevent them from continuing to consume them. Windfall apples will, of course, be attacked by the birds; this is unavoidable, but they help in feeding the poultry and reducing the food bill, although it is not desirable that poultry should be allowed to gorge themselves suddenly with windfall apples. The position of the runs is not moved from year to year, but they are large, and the poultry are occasionally removed, in order that the ground may have a rest.

In an article in the issue of the *Fruit, Flower and Vegetable Trades Journal* for 13th October, 1917, Professor F.V. Theobald, F.E.S., Agricultural Entomologist at the South-Eastern Agricultural College, Wye, expressed his opinion that the em-

ployment of poultry as a means of checking some of the insect pests of fruit is a subject that deserves far more attention than it has hitherto received. He has found that by keeping poultry in both grass and cultivated orchards, the trees, even when not sprayed or banded, are much healthier than where no fowls or other stock are kept. Among the insects readily devoured by poultry he mentions the caterpillars and wingless females of the winter moth, the maggots of the codling moth, pug moth and pear midge, slugworms, various aphides, wireworm, surface larvæ, leather jackets, the raspberry, and many other weevils. As an example of what fowls eat in an orchard, he gives the analysis of the crop and gizzard contents of a White Leghorn chicken, a case taken at random out of a number of records that he has kept. This chicken, five weeks old, killed on 25th June, contained inside it 190 pear midge maggots, 127 aphides, 12 red ants, 2 tortrix caterpillars and 1 beetle, in addition to grain, seed and other foods. A Red Sussex pullet, killed on 30th April, contained 14 leather jackets, 10 fever flies, 2 wireworms, 4 cutworms, 5 beetles, 50 ants, 7 woodlice, 4 slugs, 1 millepede and 20 larvæ of the winter moth. The light breeds of fowl, such as Leghorns, hunt the best and go further afield than the heavy breeds such as Wyandottes and Orpingtons, and in orchards of standard trees are the most suitable breeds to use for this purpose, but they will fly into bush trees or low half-standards and strip them when the fruit is ripe or nearly ripe, so that it is not safe to keep these light breeds in plantations of bush trees after the fruit is half-grown. The heavy breeds can be safely kept, even among bush fruit trees, but Professor Theobald has found that they are not such good hunters.

Without charging for rent or labour, Mr. Hall's poultry balance sheet has shown the following net annual profits for the last five years :—

<i>Season.</i>				<i>No. of Birds at Beginning of Season.</i>	<i>Net Profit.</i>	
					£	s. d.
Nov. 1st, 1914 to Oct. 31st, 1915	..	152	(138 hens & pullets)		104	1 8
" 1915 "	" 1916	..	408 (140 "	" "	141	6 7
" 1916 "	" 1917	..	542 (312 "	" "	112	1 5
" 1917 "	" 1918	..	224 (224 "	" "	237	11 5
" 1918 "	" 1919	..	285 (189 "	" "	419	19 1
Average of 5 years				.. 322 (201 "	£203	0 0

No rent has been charged against the fowls, because the ground is fully cropped with fruit, and the value of the birds' manure is estimated to be more than equal to any sum due as rent.

The cost of attendance has not been included, because it is difficult to estimate how much should be charged under this head. Mr. Hall and his son work the whole of the holding themselves, so that only a portion of their time can be charged to the poultry. They keep a cow, and also a pony for taking the fruit, eggs, poultry and other produce to market, and for working the holding. They used also to keep pigs, but they abandoned such live stock because they found that the pigs attracted rats, which caused very serious losses to the poultry. They also look after the whole of the fruit themselves, and pick the crop. Taking the year right through, Mr. Hall estimates that the attention given to the fowls amounts to about four hours per day by one person. In the winter season two hours a day is sufficient, but in the spring and summer the attention required is considerable. There are 13 poultry houses, and each house has to be cleaned out about once every three weeks. To clean out all the houses and to feed the fowls is a full day's work for one man. Up to 1917 £40 per annum was estimated to be a reasonable sum to allow for the cost of labour, but now that the minimum agricultural wage in Kent is 43s. 6d. for a 48-hour week a charge of up to £100 per annum might on present working be allowed.

Mr. Hall took up poultry keeping on a commercial scale for the first time in 1911 as the result of attending a course of lectures given by the County Council Instructor in Poultry Keeping, and he ascribes his success very largely to the instruction and advice he has received from time to time from the same source. He has been a Station Holder under the Ministry of Agriculture's Egg Distribution Scheme* since its inception four years ago. No expensive poultry houses or appliances are kept, nearly all the houses and runs being home-made. A 100-egg incubator has been used on one or two occasions in the past two seasons, but with that exception all the eggs have been hatched out under hens. The breeds of fowl kept are White Wyandottes, Buff Orpingtons and White Leghorns. They are general utility fowls, and at no time have any fancy prices been realised.

A few details of Mr. Hall's balance sheet during the last five years may be of interest. In addition to the head of poultry that are considered in this article, Mr. Hall's son has also kept about 100 head of Rhode Island Reds on the holding separately,

* Notes on this Scheme have appeared in this *Journal*, April, 1916, p. 72, October, 1916, pp. 685 and 702, December, 1918, p. 1106, and March, 1920, p. 1227.

as quite his own. He was successful in winning with a pen of these birds a prize at one of the *Daily Mail* Egg-laying Competitions at Bentley last autumn, four birds laying 286 eggs in the four winter months commencing 1st October, 1919. •

The head of poultry on the holding on 1st November of each year, belonging to Mr. Hall, Sen., with their value, was as follows :—

Date.	Cocks and Cockerels.	Hens	Pullets.	Chickens.	Total No. of Bwds.	Value. £ s. d.
Nov. 1st, 1914 ..	14	67	71	nil	152	22 13 6
„ 1915 ..	12	90	50	256	408	48 4 0
„ 1916 ..	58	71	241	172	542	96 11 6
„ 1917 ..	20	115	109	nil	244	49 10 0
„ 1918 ..	15	106	83	81	285	48 10 0
„ 1919 ..	23	168	122	84	397	73 18 0
Average of 6 years	24	103	113	99	339	£56 11 2

The cocks, cockerels and pullets have been valued every year at 5s. per head, and the hens at 3s. per head. The chickens have been valued at different prices according to their sizes, the average price being 1s. 6d. per head on 1st November, 1915, 1s. 4d. per head in 1916, 2s. per head in 1918, and 3s. per head in 1919.

The number of eggs sold for domestic purposes each year, with the average price per dozen, has been as follows :—

Season.	No. of Eggs sold.	Average Price per Dozen.	Total Receipts.
		s. d.	£ s. d.
1914-15 ..	14,231	1 9 ..	104 3 9
1915-16 ..	18,142	1 9 ..	134 7 7
1916-17 ..	26,545	2 8 ..	274 3 4
1917-18 ..	17,168	4 3 ..	310 2 5
1918-19 ..	22,675	4 5 ..	417 4 6
Total for 5 years	98,761	— ..	£1,240 1 7
Average per annum	19,752	3 2 ..	248 0 4

The prices realised have varied considerably from month to month and from year to year, according to the market price of eggs. Some of them have been sold wholesale, and others retail. The highest price realised was 8s. 4d. per dozen in October and 8s. 6d. per dozen in November, 1918, and the average price throughout the five years has been 3s. 2d. per dozen.

Eggs were also sold for setting as follows :—

Season.	No. of Eggs.	Average Price per Dozen.	Total Receipts.
		s. d.	£ s. d.
1914-15 ..	nil	—	—
1915-16 ..	2,130	3 4½	27 10 11
1916-17 ..	3,185	3 5	45 12 10
1917-18 ..	2,010	3 5	45 9 0
1918-19 ..	1,912	6 8	53 6 0
Total for 5 years	9,237	—	£171 18 9
Average per annum	1,847	4 6	34 7 9

Sittings are sold each year at a definite price per sitting, which consists of twelve eggs if they have to be despatched, or thirteen eggs if they are called for. The cost of carriage and packing has been deducted in the table set out above.

Mr. Hall, as has already been stated, is a Station Holder under the Egg Distribution Scheme, and, in addition to the eggs already mentioned, he has sold the following numbe. of sittings under the scheme :—

Season.	No. of Eggs sold.	Average Price per Dozen, in- cluding Govern- ment Grant.	Total Receipts.
		s. d.	£ s. d.
1914-15 ..	nil	—	—
1915-16 ..	1,236	3 5½	17 16 0
1916-17 ..	972	3 9	15 2 6
1917-18 ..	720	5 2	15 10 0
1918-19 ..	392	8 8	14 7 1
Total for 5 years	3,320	—	£62 15 7
Average per annum	664	4 6	12 11 1

In 1918-19 the price charged for the eggs sold under the scheme was 7s. 6d. per sitting, exclusive of the Ministry's grant. This price proved to be too high, and very few sittings were sold in consequence.

Infertile eggs were used at home and valued at 1d. to 2d. each, as set out below. The hatching results are also shown in the table :—

Season.	No. of Eggs set.	Eggs hatched out.	Percentage of Fertile Eggs hatched.	No. of Infer- tiles.	Value per Egg. (Infertile.)	Total Value of Infertile Eggs.
						£ s. d.
1914-15 ..	926	671	72	66	1d.	0 5 6
1915-16 ..	1,350	933	73	80	1d.	0 7 6
1916-17 ..	714	431	69	92	1½d.	0 11 6
1917-18 ..	1,989	—	—	128	1½d.	0 16 0
1918-19 ..	2,533	1,646	65	291	2d.	2 8 6
Total for 5 years	..	..	..	657	—	£4 9 0
Average per annum	..	..	..	131	1½d.	0 17 9

In 1917-18 there were also 165 small, cracked or double-yolked eggs used at home, which were valued at $2\frac{1}{2}d.$ each (£1 9s. 10d.), and in 1918-19 there were 99 similar eggs, valued at $2d.$ each (16s. 6d.).

During the last two seasons Mr. Hall has been selling day-old chickens, his sales under this heading being as follows:—

Season.	No. of Day-old Chickens.	Average Price per Chicken.	Total Receipts.
		s. d.	£ s. d.
1914-15-16-17 ..	nil	.. — ..	—
1917-18 ..	798	.. 1 0 ..	39 18 0
1918-19 ..	1 013	.. 1 4 ..	66 13 8
Total (2 years) ..	1,811	.. 1 2 ..	£106 11 8

Birds of various ages have been sold or killed for home use from season to season as follows:—

Season.	No. of Birds sold.	Average Price	Total Receipts.
		s. d.	£ s. d.
1914-15 ..	392	.. 3 5 ..	67 2 7
1915-16 ..	584	.. 2 10 ..	81 17 5
1916-17 ..	581	.. 3 6 ..	100 18 3
1917-18 ..	356	.. 5 0 ..	89 3 2
1918-19 ..	303	.. 6 7 ..	100 8 5
Total (5 years)	2,216	.. — ..	£439 9 10
Average per annum	443	.. 3 11 ..	87 18 0

The whole of the receipts have now been dealt with. The chief expenses, apart from labour, are food and appliances, but as the appliances are practically all home-made and home-repaired they have cost very little. The cost of the food, including cockle shell, consumed each year, and the cost of appliances, after allowing for depreciation at the rate of 10 per cent. per annum, have been as follows:—

Season.	Quantity of Food consumed.	Cost of Food.	Cost of Appliances.
	Cwt.	£ s. d.	£ s. d.
1914-15 ..	184	.. 84 0 4 ..	9 16 0
1915-16 ..	280	.. 154 12 3 ..	11 17 9
1916-17 ..	355	.. 271 14 7 ..	8 0 7
1917-18 ..	232½	.. 244 2 8 ..	3 4 9
1918-19 ..	265	.. 254 3 4 ..	17 8 5
Total (5 years)	..	£1,008 13 2 ..	50 7 6
Average per annum	..	201 14 8 ..	10 1 6

The foods used have been mainly middlings, maize, wheat, oats, fish meal, coconut cake and flaked maize, but rolled oats, meat and bone meal, linseed cake, poultry meal, chick meal, pig meal, rice, bean meal, pea meal, malt culms, dari, wheat

germ meal, groundnut cake, clover meal and bran have all been used at different times.

Mr. Hall has been his own carpenter in the manufacture of his appliances, and has made full use of old packing cases and similar articles of wood, which otherwise would have been used as firewood. The chief items in the account are creosote, nails and screws.

The only other expenditure has been for advertisements, postages, etc., which have averaged about £3 3s. per annum.

After allowing for the valuations of the feeding stuffs, poultry and appliances at the beginning and end of each year, it is possible to draw up a balance sheet and to ascertain the net profits and the return on the capital invested. It is desirable, before doing so, to put a value on the labour devoted to the poultry, and a sum of £40 has been charged for the year 1914-15, £50 for each of the two years 1915-16 and 1916-17, £60 for the year 1917-18, and £100 for the year 1918-19. The results shown by the balance sheet are then as follows:—

Season.	Total Receipts.			Total Expenditure.			Net Profit.			Capital Invested.			Return on Capital.
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	%
1914-15	233	12	10	169	11	2	64	1	8	52	13	6	121
1915-16	400	11	3	309	4	8	91	6	7	82	1	0	111
1916-17	540	19	0	478	17	7	62	1	5	129	3	8	48
1917-18	640	5	8	471	14	3	177	11	5	104	10	6	170
1918-19	788	3	5	468	4	4	319	19	1	146	16	9	218

Total (5 years)	£2,612	12	2	1,897	12	0	715	0	2	—	—	—	—
Average per annum	522	10	5	379	10	2	143	0	0	103	1	1	134

The capital invested has been taken as the value of the food, cockle shell, birds, houses and appliances, etc., at the beginning of each year. With the cost of labour as estimated above, and without charging rent, the net profit on the poultry has been £143 per annum, and on an average of the last four years there has thus been a return of 137 per cent. per annum on the capital invested.

It is not possible to publish here the complete balance sheets for the different years,* but a summary of last season's balance sheet is given as an illustration (p. 358).

It is evident that the poultry have proved exceedingly profitable. The five years under consideration have all been years of war, and prices have been high in consequence, but

* Full details of the accounts for 1915-16 and 1918-19 have been printed in the Yearbook of the National Utility Poultry Club, reprints of which can be obtained, price 2 ½d. carriage paid, from Mr. W. Hall, Grover Hill, West Peckham, near Maidstone.

the price of feeding stuffs has been high, as well as the price of eggs and chickens. Every keeper of poultry cannot expect to get such satisfactory results; they can only be obtained by good management and suitable conditions. There is no question, however, that poultry keeping is an excellent adjunct to fruit growing for a small holder, and that with skill and knowledge profitable returns may be confidently expected. It is interesting to note that on 1st November, 1914, Mr. Hall possessed 152 head of poultry, of which 138 were hens and pullets, and that in five years he sold—

	£	s.	d.
98,761 eggs for domestic purposes at 3/2 per doz.	1,240	1	7
12,557 „ for setting at 4/6 per doz.	234	14	4
657 infertile eggs at 1½d. each	4	9	0
1,811 day-old chicks at 1/2 each	106	11	8
2,216 birds of various ages at 3/11 each	439	9	10
Total	£2,025	6	5

His stock at the end of five years had increased from 152 to 406 birds, and his food bill for the five years amounted to £1,008 13s. 2d.

TOMATO CULTURE.

J. STODDART,

Horticultural Inspector, Ministry of Agriculture and Fisheries.

As a comprehensive leaflet dealing with tomato culture is now being prepared in the Horticultural Division of the Ministry, it is not proposed to deal fully with the subject in this article. Some points have therefore been selected which are not known to or are overlooked by many tomato growers, or on which opposing opinions are held.

Local Conditions.—No hard or fast rule can be laid down with regard to culture, as tomatoes are a crop which vary to an extraordinary degree with local conditions. It is advisable, on this account, for the grower carefully to observe and study the methods and results of other cultivators in his district. Varieties and methods which are quite successful in one part of the country may be of much less economic value in another part. Ruling climatic conditions, soil formations, etc., all have some effect on the ultimate success of the crop.

Soil and Sub-soil.—The habitat of most *Solanums* is a light and sandy soil, and in tropical countries they thrive in such a soil when other plants can scarcely gain a footing. This indicates a light soil for artificial culture, and practice bears it out. The ideal soil would be a light loam of fair depth over sand or gravel, or a well-drained alluvial soil. Heavy and successful crops are grown on brick-earth land where the drainage is good. Clay soils should, if possible, be avoided, as they predispose the crop to the many fungoid diseases for which there are no remedies at present. Where clay soil must be used, thorough drainage is essential, and the top soil should be heavily limed and thus made rich in humus and of good tilth.

Seed.—The proper selection of seed is easily the most important item of tomato culture. As one ounce of seed may produce £350 worth of fruit, the cost is of little importance so long as a pure strain of the most suitable variety is obtained. There are many excellent and well-tried market varieties offered, but these should invariably be purchased either from the original raiser or some firm of seed growers of good repute. The grower who, from motives of economy, saves his own seed, often defeats his purpose, as accidental cross-fertilisation may, in the course of a few years, take the strain clear away from the original, and the imagined economy thus prove in the end a considerable loss.

Sowing.—The soil used for raising the seed should be fairly rich, and sifted through a medium sieve. Damping off of seedlings may, in many cases, be avoided by steaming the soil and boxes, or by treating them with a 2 per cent. solution of 40 per cent. Formaldelyde, before sowing. Labour in raising seedlings may be saved if, instead of sowing closely and pricking out the seedlings, the seeds are sown separately $1\frac{1}{2}$ in. apart in the seed boxes. By this means no removal is necessary until the plants are potted. A smooth board, fitting the seed box, and studded with hob-nails at the proper distances, is an easy method of marking the distances. A 'perforated iron plate, through which the seeds are dropped, may also be used for this purpose. During germination the boxes should be covered with glass and the temperature maintained at 70°F. Excessive watering encourages damping off, and all water used should be the same temperature as the soil.

Potting.—When the plants have reached a height of about 4 in. they should be transferred to small 60's pots, a moderately rich soil being used. One part of sifted straw manure to four parts soil is a good mixture. When the plants have reached a height of 9 in. to 12 in. it is customary to plant out direct into the final situation in the ground, but from observations over some 15 years the writer considers that it is advisable, particularly for early crops, to pot on into 48's, in order that the plant may throw its first truss of bloom. Plants which fail on the first truss can be discarded, and where the soil of the borders is rich the risk of rank growth of foliage and consequent failure of bloom is avoided. The extra labour involved is considerable, but is usually more than justified by results.

To save the labour entailed by handling a large number of small 60's pots, large boxes, 4 in. to 5 in. deep, are often used, the plants being spaced 4 in. apart. When this method is followed lack of uniformity results, and a large proportion of plants may be drawn and spindly. The risk of damage to the roots when separating for planting out is considerable.

Planting Out.—Distances and methods of planting must naturally vary with the size of the glass house. The average "plant" of large market nurseries is 17,920 per acre, or approximately $3\frac{1}{2}$ plants per square yard. In wide houses the usual method is to plant in rows across the house 27 in. and 18 in. apart alternately, the plants being 12 in. apart in the rows, leaving one, or in very wide houses two, paths along the length of the house. In low narrow houses three or four rows length-wise along each side of the centre path, with the plants 12 in. apart in the outside rows and 24 in. apart in the inner rows, is suffi-

ciently close planting if adequate ventilation is to be maintained. With this method the outside and inner rows only should be run up the roof, the other row or rows being stopped when the glass is reached.

Watering.—As soon as the plants permit, usually about a fortnight after planting out, or when the first truss of fruit is set, a mulching of straw manure should be given. In addition to supplying manurial material, mulching has an important effect on the water supply of the plants. It prevents rapid evaporation, and by keeping the surface of the soil in an open and moist condition encourages the roots to develop in the surface of the soil, where they are more easily controlled.

When the soil contains a plentiful supply of manure, water should be given very sparingly until the first truss is set, as otherwise there is a danger of the plants making a very rank growth and failing to set the first and second trusses. Where the soil is well drained a liberal supply of water should be given, not in frequent doles which only wet the surface, but in heavy waterings two or three times a week, according to the weather. When possible, it should be done on bright, dry days, in order that full ventilation can be given to disperse the damp air produced by the watering. Water, whenever possible, should be of the same temperature as the house, as cold water tends to check growth.

Stopping.—All lateral growth should be removed as the plant progresses, but on the question of "stopping" there are diverse opinions. Some urge that the plant should have further growth stopped as soon as the glass is reached, in order that all energy may be devoted to the maturing of the fruit already set. Others allow the plants to run up the wires and form a thick mass of vegetation, in order to crop as long as possible. Given a deep and rich soil at the start it is possible to run the plants on and get fruits which will average 6 to 8 to the lb., but if there is not enough body in the soil to do this, "chats" only result, and it is better to "stop" and clear the house for another crop.

Manuring.—Two distinct methods of manuring are in vogue, each of which has its supporters. The first is the addition to the soil of a sufficient supply of manure to serve the crop to the end, and the second is to plant in unmanured soil afterwards, feeding with frequent top dressings of soluble manures. Both methods produce successful results, but the writer is convinced that a longer crop finishing with good fruit is obtained by the first method. When the plants are old they do not seem to respond fully to the application of top dressings.

The question of the nature of artificial manures cannot be fully discussed here, but it is a safe rule to use organic materials where possible, in insoluble form, such as bone meal or flour when dug in, and dissolved bone or guano when used as a top dressing. Potash must, of course, be mineral and soluble.

Lime should never be overlooked, not because it is essential to the tomato, but because it assists the assimilation of the plant foods present in the soil and also possesses useful insecticidal properties.

Picking, Grading and Packing.—Fruit which is intended for distant markets should be picked at least 24 hours before it is fully ripe, as in this condition it travels better, and will be quite ripe by the time it is retailed to the consumer. The fruit should be graded as follows:—(1) *Pink*—fully coloured, uniform in size, smooth, round and firm, averaging 5 or 6 per lb. (2) *Pink and white*—good colour, uniform in size, smooth, round, and firm, averaging 6 to 9 per lb. (3) *Blue*—sound, shape and colour not perfect, smooth, round and firm, with no fruits less than 10 to the lb. (4) *White*—sound, colour and shape not perfect, small, and averaging 16 to the lb. (5) *Blue and White* or *Chats*—very small, undeveloped fruits (6) *Pink and blue* or *Roughs*—large, badly shaped, diseased, and discoloured fruits. The colours given indicate the colours of paper used for lining the baskets. The chief packages used are 12 lb. chip and 12 lb. wicker strike, which should contain a full 12 lb. when packed. A label indicating the grade and net weight when packed should be tied on the outside of each package in such a manner that it is not removed when the cover is taken off.

Measures against Disease.—There are numerous fungoid diseases which attack tomatoes and for which there are no really satisfactory remedies when once the plants are attacked. Cleanly methods, careful attention to ventilation and watering, and the removal of all weeds both inside and outside the houses, promote a sound and healthy growth which enables the plant to resist attacks to a very large degree. Where successive crops are grown in the same soil, thorough disinfection of the house and sterilisation of the soil by one of the many carbolic preparations are essential.

In conclusion, the writer desires to impress upon readers the fact that the most important elements making for success in tomato growing are, careful work, careful thought, and clean culture. Methods may vary, but if these important factors are neglected a full measure of success is never attained.

FORAGE CROPS OF DENMARK.

W. H. PARKER, M.A.,

Director, National Institute of Agricultural Botany.

ON a casual glance through a current table of agricultural statistics, the eye will encounter the following item :—

"*Denmark.*—Acreage under roots for feeding (mangolds, swedes and turnips), 1919, 678,000 acres"—a bald statement, not worthy, apparently, of much serious thought on the part of the British agriculturist.

It has been part of Mr. Harald Faber's obviously congenial task* to prove the fallacy of such an impression ; and well has he done his work. His book is small, only consisting of a hundred pages (exclusive of the excellent foreword written by Sir Robert Greig), but each one of those pages contains material which should be studied with care by all who have at heart the progress of British farming.

Growth and Improvement of Root Crops.—Mr. Faber has divided his material into four chapters, the first two of which deal mainly with roots. He starts by describing the prejudice with which Danish farmers of the 'sixties, 'seventies and 'eighties regarded the practice of growing roots for cattle feeding, and states that their main contentions were that cows so fed gave milk of poor quality, that the butter became tainted, and, especially, that it was uneconomical to grow a crop of which the largest proportion was water.

The first factor which contributed to the correction of these ideas was the publication of the results of a series of experiments carried out by N. J. Fjord, of the Royal Agricultural College, Copenhagen. In 1888 he started, in co-operation with certain Danish farmers, a series of practical feeding trials with pigs and cattle. The results obtained by 1890 may be summarised as follows :—(1) He proved that, with the exception of the criticism as to water-content, the farmers' objections were groundless ; (2) It was shown that roughly 8 lb. of roots were equal in feeding value to 1 lb. of corn, but that the feeding value of different varieties of roots was directly proportional to their content of dry matter, 1 lb. of dry matter equalling 1 lb. of corn. The farmers soon calculated that one acre of land could, on this basis, either yield about 1,900 lb. of food as corn, or 5,107 lb. of dry matter of equal value, lb. for lb., when under roots. They grew roots but demanded varieties with small water-content.

Fjord's experiments were well planned, as every reader of

* Harald Faber: *Forage Crops in Denmark* (Longmans Green & Co., London, 1920, 6s.).

Mr. Faber's book will agree, and they were so designed that the conclusions to be drawn were obvious to all ; but, as regards scientific accuracy and refinement of method, they have since been completely outclassed by experiments dealing with the same problem carried out at Cambridge University between 1902 and 1909 by Wood, Berry and Middleton.*

The Cambridge experiments confirmed conclusively the results obtained from Fjord's trials, but it can only be with a sense of shame that the British agriculturist contemplates the contrast between the effects of these two sets of experiments in their respective countries. What these were in Denmark Mr. Faber describes most lucidly in his second chapter. He shows us how ready the Danish farmer has always been both to instigate and to profit by the results of research. Much had already been done towards the improvement of farm crops by selection, and the Danish Seed Testing Station (the earliest extant) had already made its influence felt in the direction of encouraging the use of home-grown seed. So it happened that all was prepared for the widespread application of the results of Fjord's work ; it only needed the man who should disseminate the knowledge and point out the best means of applying it. That man was L. Helweg, who had already started supervising and reporting on root trials in 1886. Everyone will follow with interest Mr. Faber's account of the succession of painstaking cultural experiments by which Helweg obtained evidence of the superiority of home-grown seed over that imported from the best foreign firms, and his investigations to discover which of the varieties gave the highest yield of dry matter per acre under varying conditions of soil and climate in Denmark. This, however, did not suffice, for his trials had proved, by that time, that there were, within the varieties themselves, races or "strains" which contained larger or smaller percentages of dry matter, and that these differences were inherent in the races, and were transmitted through the seed to their descendants. Helweg, therefore, devoted his energies to the discovery of the superior races, and, having done so, he published the names and addresses of the vendors of the seed.

The farmers were not slow to use the knowledge obtained for them, and to-day root seed, unless it has come from a race which has been proved 1st class in the comparative trials, is unsaleable in Denmark. No farmer will be deluded into buying seed from roots which merely look pretty and give a high total

* Wood and Berry : *Journ. Agri. Sci.*, Vol. I., Part 2, p. 176. Wood. *Ibid.*, Vol. III., Part 3, p. 225.

yield per acre. "Dry matter per acre" is their criterion, and there is not an agriculturist in Denmark who quarrels with this standard of valuation. Not only has this principle since held its own in the great test of time, but it is gaining supporters daily beyond the confines of Denmark. Sweden has adopted it to the full, and Germany is already deciding in its favour.

And now, the contrast. The British farmer, if he has ever even heard of the Cambridge experiments, has forgotten them. He still continues in the old path of growing for looks and total yield; nor does it trouble him that quite an inordinate amount of that yield consists of water. When will he wake up? It is he, and he alone, who sets the standard, and it is in the nature of things that the seed merchants, as becomes good business men, supply him with what he demands.

In addition to the more obvious benefits resulting from Helweg's work, it has performed another great office; it has done away completely with that tiresome system, particularly prevalent in England, of employing an infinite number of trade names of one and the same variety. The competitions have actually driven out of Denmark all but five named strains of mangolds, and the number of strains of turnips and swedes has been similarly decreased.

Simultaneously with bringing down the number of strains, the work of Fjord and Helweg must be considered to be directly responsible for the amazing increase in acreage under roots in Denmark. This increase speaks for itself when we read that in 1888 it was 95,000 and, as already mentioned, had become 678,000 in 1919, an increase roughly of 600 per cent.

Experts may have different views as to the scientific accuracy of the methods employed in the Danish trials, and as to some of the conclusions drawn from them, but one great cardinal fact remains—they have decisively and completely fulfilled their object, and have set an example which one can only hope will be followed without delay in Great Britain, where there are already many fervent admirers of the patience, persistence and capacity which Helweg has brought to his great task. He is now an old man, but when the writer lately spent an evening with him in Copenhagen, discussing his life work, his enthusiasm was as unabated as his natural powers are undimmed.

For full details of how the work was performed, of the method by which ever-improving races are continually replacing the older ones, and of the large profits obtained by their fortunate producers, Mr. Faber's book must be directly consulted. In it will also be found complete descriptions and histories of the races of mangolds, turnips and swedes now popular in Denmark.

Grasses and Clovers.—As a natural sequel to his description of Helweg's work on roots, Mr. Faber devotes his third chapter to an account of the improvement which has been made in grasses and clovers. The information is less detailed than that contained in the preceding chapters, but contains much which should be read with special care at the present time when we are just discovering what great advantages accrue from the use of indigenous races when laying land down to grass. Mr. Faber starts by describing the work of P. Nielsen on the improvement of pastures, and his researches to find appropriate mixtures for seed leys; but the greatest advance, the improvement of races of grasses and clovers, was the direct result of the adaptation of Helweg's methods to those crops, and was not begun until 1908. In that year the State determined to arrange for comparative cultivations of the above-mentioned crops in order to discover the best races, the standard of comparison being yield of hay. Foreign strains were included in the trials, but here, again, home-grown seed always proved of greater worth. As a result of the interest aroused by these trials, the acreage devoted to grass-seed culture has increased from 10,600 in 1901 to close upon 78,000 in 1919, and Denmark, from being a large importer, has now become an exporter of grass and clover seed. The majority of the seed, both for home and for export, is grown by farmers' co-operative associations, and their seed-cleaning establishment at Roskilde is imposing evidence of the excellence of their organisation.

As an example of the confidence placed in the results of the trials, it may be mentioned that the seed from the best Italian rye-grass strain (Danish grown), in all 12 cwt., was sold in 1912 at the rate of about £450 per ton.

Mr. Faber states that despite the short time that these trials have been running, they "have done away not only with the bad seed, but also with the dishonest and the ignorant seed-merchants; and, with them, have disappeared the florid advertisements of indifferent strains with high-sounding names"—truly a consummation much to be desired by any country.

The Seed Trade.—The last chapter is devoted to "Guarantees in the Trade in Seed." In it we are told something of the development of the Danish Seed Testing Station between the time of its foundation by E. Miller-Holst until the present day, when it is directed with infinite zest and capacity by Dr. Dorph-Petersen. The origin of the Danish system of "automatic control" is recounted, by which seed firms selling two-thirds of the seed used in Denmark have voluntarily bound

themselves to submit to control by the Seed Testing Station all seed sold. They guarantee purity, germination, maximum proportion of weed seed, etc., and, should the tests made by the Station prove that a bulk of seed sold is below guarantee, compensation is automatically paid to all customers who have been supplied with any of this bulk. The author gives a very lucid exposition of the detailed working of this scheme and of the results obtained. Interesting though the scheme is, it does not demand special attention here in England, for, if the new Seed Bill becomes law, the British farmer will be satisfactorily safeguarded in these respects.

The last portion of the chapter, however, shows a unique departure in seed trade practice, namely, the guarantee voluntarily given by the Danish seed merchant that the seed sold by him is of the strain indicated, and that full compensation will be given to the buyer for the smaller yield resulting if it should be found that seed of another and inferior strain has been delivered. This development is the latest result of Helweg's work. It arose as a consequence of the great financial value of seed from strains of roots which had done well in the comparative trials. The reputable seedsmen found that certain of their competitors were unscrupulously selling inferior seed as one of the 1st class strains, thus robbing them of the results of their time and labour, as well as discrediting their wares. They saw at once that only honest traders could give this guarantee, and would have nothing to fear from its effects, whereas unscrupulous or inefficient dealers could not afford to take the risk, and, by refraining from giving the guarantee, would acknowledge themselves to be unreliable, and would in consequence soon be deserted by their customers. This, in effect, has happened, and where at first only root seed was so guaranteed, the practice has now spread to grasses and leguminous seeds used in rotation leys. Mr. Faber does not mention it, but preliminary work is now on foot in Denmark with the object of immediately extending the guarantee of genuineness to cereals also.

Mr. Faber fully explains the method by which the guarantee is checked, to the satisfaction of both trader and farmer.

By this new publication the debt which British farming already owes to Mr. Faber for his previous book, "Co-operation in Danish Agriculture," has been still further increased. Everyone who reads "Forage Crops in Denmark" will put it down—and return to it—with a feeling of intense admiration for Mr. Faber's great little country, not, it may be hoped, unmixed with a resolve to profit by the lessons so ably described.

THE TEMPORARY LEY AND THE IMPROVEMENT OF GRASS LAND.

IN a lecture given at the Bath and West Counties Show under the auspices of the Ministry and as part of the latter's grass-land campaign, Professor R. G. Stapledon, M.A., of the University College of Wales, Aberystwyth, stated that if British agriculture is to be of maximum service to the Nation, and is to give the fullest recompense to the farmer, a proper balance must be maintained between crops and grass. He mentioned, also, that owing to the high price and scarcity of all foodstuffs, this balance will tend more and more in favour of the plough. He felt convinced that while less permanent grass is wanted, what we retain of any and every kind of grass must be every inch of it productive. Our derelict grass lands are our agricultural slums, and to begin all over again with a new system of rotations might prove to be the best method of improvement.

Grass land improvement is largely effected by the use of wild white clover and phosphatic manures, and of productive instead of half productive temporary leys. It is necessary, therefore, that we should have phosphates, white clover and good seed of the proper kinds for leys.

In considering the possibilities of effecting improvement of grass land the following questions should be asked:—(1) Will any field that is to be improved respond quickly to surface treatments? (2) Would it be better to break the sod and begin again? (3) If it is a case of beginning again (a) would it be better to get it down with a permanent mixture as soon as possible, or (b) would it be better to alter the scheme somewhat, taking a rotation plus the four-year ley around the farm, rather than ploughing one corner of a farm and leaving the rest as permanent grass?

The Temporary Ley.—Professor Stapledon dealt first of all with the temporary ley, and pointed out that it is quite certain that this kind of ley will not justify itself unless:—(1) It can be established rapidly and with reasonable certainty; (2) It will be practically uniformly productive over the whole period of four years (in some districts a three- and in others a five- or six-year ley may be more advantageous); (3) It will give per annum as much keep as or more keep than a permanent pasture under the same conditions of soil and climate; (4) It will impart as much fertility to the soil for subsequent arable crops as a broken permanent pasture—possibly more.

The lecturer advised late sowing, and referred to the value of rape as a nurse crop. It is essential to reduce the seeding per acre to the minimum, and with greater attention to the preparation of tilth, the question of nurse crop, depth of sowing, and the precise time and weather conditions under which to sow, the seeding per acre could often be reduced, in some cases perhaps by 50 per cent.

The experience of the lecturer has indicated that it does not matter very much at what time seeds are sown between the middle of May and the end of July or middle of August, provided that they go down on a good clean tilth not too deep, and during a 10- to 14-day spell of warm showery weather.

The Choice of Seeds Mixture.—The first essential in a plant for sward promotion is "late maturity," *i.e.*, late flowering, which is not necessarily correlated with late production of leaves, but only with greater production of leaves. Wild white clover and late-flowering red clover form the bedrock of a good ley. The former gives density, contends against weeds and builds up the fertility. The latter is the red clover for a ley, because it lasts; good strains may last for four years, and others will invariably last for two. The lecturer urged his audience to be more careful about their stocks; to concentrate far more on late-flowering red clover; to build up strains derived from seed long grown in this country and not from imported seed; to take care to grow for seed on a clean field; and to grow specially for seed by sowing in drills and keeping the fields scuffled.

Professor Stapledon stated that he would rather depend on the few species of clovers and grasses that offer certain success than include a large number as a sort of "shot at a venture." In his opinion it would be desirable to purchase wild white clover ($\frac{1}{2}$ lb. per acre is often enough), late-flowering red clover, good cocksfoot, rough-stalked meadow grass and Timothy.

With the help of wild white clover and with careful management one can establish a temporary ley that will savour strongly of the permanent sward. As years go on, a wider selection of valuable strains of herbage plants should certainly be available. The ley, too, will often have the advantage that it will be much less weedy.

Top Dressings.—If phosphatic manures do not produce the desired results, the reason may generally be attributed to one of the following limiting factors:—

(1) *Scarcity of Potash*.—This is sometimes the case on sandy soils or on peats. In the case of meadows the deficiency is much assisted by dressings of farmyard manure. On pastures, mineral phosphates should be applied, but only after the deficiency has been proved as a result of small scale trials.

(2) *Almost complete Absence of leguminous Herbs*.—This may be rectified by renovating mixtures consisting largely of wild white clover. In wet climates, where the turf is dense and bent abounds, it is difficult to get any sort of seed bed for a renovating mixture. On drier and on calcareous soils a sufficient crumbly tilth can often be obtained, and renovating mixtures sown in wet weather are often successful.

(3) *Physiological Dryness of the Soil*.—This may be due to a dense matted turf which actually prevents rain properly reaching the soil below. Rough swards should be heavily grazed with ponies and lime applied; improvement can only be slow. It is difficult to improve the swards on very dry sands by surface dressing, as the soil needs abundance of organic matter which requires to be ploughed in.

(4) *Swards full of Weeds*.—These are slow to improve by top dressing, and in order to reduce mat herbs it may even be necessary to apply a mixed dressing, including ammonium sulphate, although under ordinary conditions it is not a sound practice to apply nitrogenous fertilisers to pastures. On a rough turf it is a great advantage to harrow in top dressings with a toothed harrow.

Breaking the Sod.—It is most desirable that the sod should be broken (1) when there is a coarse, matted sward, (2) where leguminous herbs are absent on a dense turf, and (3) on very dry, sandy soils. In the last case soiling crops should be ploughed in, the field sown down with a cheap mixture consisting largely of rib-grass, grazed with sheep, rebroken after two years, soiling crops again ploughed in, and the land finally re-seeded with a good mixture. The need for breaking the sod is indicated even on fairly good fields if full of weeds.

A good case for breaking can, however, often be made for entirely different reasons, namely, where the soils do not carry high-class permanent pastures. There can be no doubt that a grass rotation carried over the whole farm would give far more grass keep, hay and grazing, and more both cleaner and better arable crops than a part of the farm under permanent grass and the rest under rotation with but the one or two-year ley. It was from this point of view that the lecturer wished the question to be considered. Such grass-land farming would,

of course, imply a whole sequence of high-grade leys, some designed more particularly for hay and others more for pasture. This would mean more ploughing out of sward than in the "water-tight compartment" method; but in wet climates it should be a decided gain, for frequently days too bad to plough arable are suitable for breaking sward.

Breaking is, of course, the last resort on the heavy, unworkable clays, and if such fields are broken there would be much to be said for the double summer fallow. If inaccessible fields, or steep, hilly, or badly-shaped fields are best broken, it would be a distinct advantage to get them down to grass again without a second ploughing. On friable soils in wet districts this can be done with every promise of success by the method of rape pasturing advocated some years ago by Mr. Wibberley.*

Proper Grazing.—No matter what method of grass-land improvement is adopted, the maximum benefits can never be obtained unless grazing is properly regulated, and unless also the grazing is heavy in proportion to the amount of keep, that is to say, in proportion to the success of improvements. Speaking very generally, there is far more harm done by under stocking than by over stocking. What is wanted is a sort of rotation system of stocking, store cattle following fattening animals, sheep following stores, rather than competitive mixed grazing. Intensive grass-land management is not compatible with large enclosures; the enclosures need to be varied in size according to the time of the year, the weather conditions and the type of animals grazed.

In conclusion, Professor Stapledon remarked that the temporary high-class ley taken over a farm leaves its legacy in fertility, makes rotations elastic, and surmounts to some extent the difficulties connected with the present shortage of fertilisers. In the present uncertain state of the world's food supplies the nation which can devise a system of agriculture that can be rapidly made subservient to any sudden and unforeseen need, without at the same time disorganising the industry, will have achieved security against shortage. The pivotal crop in a general emergency rotation (and who can say what it will pay the farmer best to grow two or three years hence, or what the nation will most need) is not wheat, nor oats, nor roots, but is the high grade temporary ley.

* See this *Journal*, November, 1914, p. 701.

CHICKENS AND RABBITS: PROFESSOR PUNNETT'S EXPERIMENTS.

THE important experimental work now being carried out at Cambridge by Professor R. C. Punnett, F.R.S., has a vital bearing on the development of the poultry industry. That branch of small live stock keeping is receiving the special attention and care of the Ministry through its Rural Industries Branch, and together with poultry breeding a strong effort is being made to foster rabbit breeding as well. Professor Punnett's experiments, although they are in some respects in their infancy, should add much to our knowledge of scientific breeding.

As far as poultry is concerned his researches point to certain modifications. It may be well, for example, to breed from coloured strains in preference to all-white, because in the all-white it is impossible to tell the sexes apart on hatching. At the same time, it is true that the all-whites are about the best utility birds *at present*. High laying qualities are transmitted especially by the male, and consequently where laying-strain birds are concerned, cockerels must be kept for store. The flocks of White Leghorns and White Wyandottes are beautiful to look upon in proper surroundings, but their superiority does not arise from any thing inherent in the white that makes for better laying, but because more attention has been paid to it in the way of selecting and breeding from the best laying stock. Professor Punnett holds that were equal attention paid to coloured strains, these might be made just as good. In that case, they would be preferable, because the surplus cockerels could be eliminated on hatching. Silver and gold crosses may be kept with advantage. For example, Professor Punnett recommends the brown Leghorn cock and silver grey Dorking hen, or black Leghorn cock and Plymouth Rock hen, or black Leghorn cock and Cuckoo hen, or Buttercup cock and silver Wyandotte hen. The result of crossing is curious. All the progeny of a gold cock and a silver hen reverse the colours. The cocks are silver and hens golden. Even at birth, and this is an important point, the differences can be seen. Professor Punnett showed this by an illustration in a recent article in this *Journal*.* He advocates the immediate killing of the male birds, so that the trouble and expense of rearing go only to the pullets. Elsewhere he has discussed the superiority of cross-bred pullets over pure strains for general purposes of egg production. By cross-breds he does not mean mongrels, but

* The issue for February, 1919, p. 1319.

first-cross birds from pure strains. The cross-bred is not a better egg-producer; its merit lies in its superior vigour. The losses at hatching and at all stages of life are very much smaller, and this is an important point, because one cannot expect the majority of small raisers to be highly skilled. Even if the cross-bred were a poorer layer, the ultimate advantage would lie with it, because, generally, it does so much better.

In his researches on rabbits, Professor Punnett points to the necessity of getting rid of comparatively unproductive or valueless breeds and concentrating upon the production of fur and flesh. For the first purpose, he advises close consultation with furriers. The quality of the skin results from the presence of various types of hair, and research on Mendelian lines has not yet advanced far enough to provide a structural analysis that will make results sure. There are many qualities of fur. At present we know nothing of the inheritance of fur "quality" as opposed to "colour." "Colour" analysis is fairly complete, although there are still some points to unravel. "Quality" analysis is only beginning. Further points urgently requiring experimental research are *early maturity*, *size of litter* and *time of moult*. At present, Professor Punnett is not investigating any of these, because his plant is not big enough to permit of such experiments. These questions ought, however, to be undertaken as early as possible, so that this country may be in a position to capture its share of the trade in natural rabbit fur, which is going to develop very rapidly, owing to the world shortage of fur generally. "Blues" and "Chocolates" are the best skins on the market, and the result aimed at is an increase of size with a maintenance of quality.

It is clear from Professor Punnett's work that if we are to make the best of our poultry and rabbits, the old methods will suffice no longer. The cost of food and labour has risen so much in the past few years that the expenditure made upon live stock must be such as will produce a commensurate return. Utility stock costs as much to keep and to care for as the most carefully selected strain, but the return from the market is comparatively trifling. Few people realise that if they will take the trouble to study the work that is being done on their behalf by men whose interests are entirely scientific and have no association with commerce, they can learn to turn their hobbies to the best advantage. Many of our best-equipped men of science are now investigating problems of vital interest to the beginner who keeps a few head of stock in his garden, or on his allotment. Will he turn and consider what they have to teach him?

INSECT AND FUNGUS PESTS IN JULY AND AUGUST.

It is proposed to include periodically in this *Journal* notes on insect and fungus pests which are likely to be troublesome in the month following publication. In most cases the damage done by the pests which are obvious on the various plants at this time of the year cannot be checked, but it is hoped that the notes will help growers and others to recognise the pests attacking their crops so that they may take steps in following years to prevent a similar attack. If growers are uncertain as to the nature of any particular pest or disease, a specimen, carefully packed in a tin box, should be sent to the Ministry, 72, Victoria Street, London, S.W. 1, for identification and advice.

Vegetables.—In most parts of the country *Potato Blight* may be expected to appear about the middle of July; it had already, by the middle of June, appeared in the south-west. Its general appearance is now fairly well known, but for the benefit of those who have not seen its early stages it may be stated that the disease usually appears first in the shape of one or more blackish spots or blotches on the leaflets. On looking at the under surface a similar spot will be found, but this is surrounded by a white or greyish ring of mould. This mould is composed of the fine filaments or threads of the fungus, which have come to the surface of the leaf to produce the spores or "seeds" of the disease, which the wind spreads broadcast. As the disease is internal, little or nothing can be done to check its course in the plant, but its spread to healthy plants should be prevented by spraying with Bordeaux or Burgundy mixture. Copper salts, the poisonous constituent of these mixtures, are very deadly to germinating spores, and, if sprayed on the plant in a neutral (non-acid) form, so that a thin film remains on the leaves, the plant is protected from an external attack. Germinating spores coming into contact with the copper salt are killed and, therefore, unable to enter the leaf.

The question as to whether *Potato Disease* will become epidemic rests very largely with the climatic conditions. In the south-west and in Ireland, where summer conditions are usually warm and damp, spraying of potatoes is absolutely essential if a healthy crop is to be obtained, but in England

generally, apart from the south-west, such conditions only obtain occasionally, and usually for a limited period. Hence farmers and others often take the risk of weather conditions being favourable, and refrain from spraying. In connection with potato spraying it should be noted that severe foliage injury has occurred where potatoes badly attacked by aphides have been sprayed with copper fungicides. Under such conditions, especially in the drier districts, it is perhaps wiser not to spray.

Particulars as to the making of these spraying mixtures and precautions that should be taken are stated in the Ministry's Leaflet No. 23.

Most of the potato diseases will now be in evidence, and growers lifting first earlies may find potatoes with warts or protuberances upon them. This is, most probably, the dreaded *Wart Disease* (Figs. 1 and 2), which, if present, should be at once notified to the Ministry or to the local police. The appearance of the disease is unmistakable (see Leaflet 105), although sometimes a bad attack of "ordinary scab" is liable to be confused with it. This "ordinary scab" is merely a surface disease, and has little effect on the crop beyond spoiling its appearance.

Leaf Curl is another disease which very seriously reduces the yield of the potato crop. Curled plants may be recognised by their dwarf appearance and the fact that the lower leaves are markedly curled. The produce of such plants is always below the normal, and in bad cases the crop is almost nil. The tubers from these plants, being of small size and of normal appearance, are apt to be set aside for "seed." To do this, however, is a great mistake, as tubers from curled plants yield a curled crop again, with an increasingly low yield. If home-saved seed is required the healthiest plants should always be selected for "seed," and if curl is at all prevalent, no "seed" should be saved from the plot. In dry and southern districts fresh northern seed should be obtained each year. (See new edition of Leaflet No. 164, and article in the issue of this *Journal* for last month, p 287.)

Pests on other vegetables will be plentiful and the various caterpillars of the Cabbage Butterflies and Cabbage Moth will be attacking the *Brassicas*. In gardens and small plots much can be done when the butterflies are noticed by turning over the leaves and crushing between the thumb and finger of the gloved hand any batches of eggs which may be seen, or, if the eggs have hatched, by noting the small



FIG. 1.—Tuber of Arran Chief, showing Wart Disease.

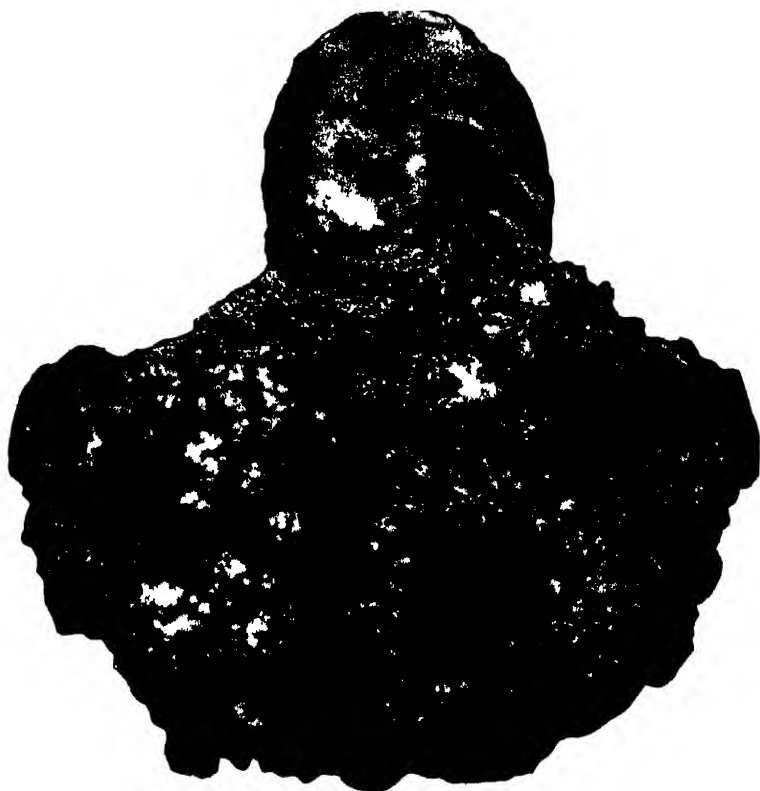


FIG. 2.—Tuber badly attacked by Wart Disease and commencing to decompose.

holes which the young larvae have eaten, and destroying the larvae before they have scattered. (See Leaflet No. 109.)

On celery, the damage done both by the *Celery Fly* and the "*Celery Blight*" may be found. It is somewhat late to begin treatment, but some steps may still be taken. If the attack of "*Fly*," which causes blisters on the leaves, is slight, the larvae may be pinched between thumb and finger or the leaves pulled off. This will go far to prevent damage later in the season. In the case of the *Blight*, which is caused by a fungus, spraying with Bordeaux mixture may prevent further spread of the disease, but another season this should be put on much earlier, while efforts should be made to obtain seed which is guaranteed free from the spores of the fungus causing this disease. (See Leaflet No. 238.) Prevention in the case of the *Celery Fly* consists in spraying with a strong smelling wash, such as a paraffin emulsion, which will mask the odour of the celery and therefore prevent the fly from being attracted to it to lay her eggs. This method should be noted in connection with flies which attack other vegetables, such as the *Carrot Fly*, *Cabbage Fly*, *Onion Fly*, etc. These can seldom be destroyed once they have attacked the host, but may be prevented from laying their eggs by a method similar to that suggested above, although in the case of these insects, ashes or sawdust damped with paraffin may be used to sprinkle at the base of the plant.

Fruit.—In some plantations and gardens a further brood of *Gooseberry Saw-Fly* larvae will now be in evidence. Here, again, hand-picking in gardens is most effective if it is done while the larvae are still young, for then they are largely confined to a few leaves, which are indicated by a large number of small holes where they are feeding, and the removal of such a leaf will mean the destruction of 20 to 30 caterpillars. Very small caterpillars may be destroyed by a carbolic soap solution, while, since all the berries will have been picked, the pest may easily be dealt with by means of a poisonous wash. (See Leaflet No. 12.)

Brown Rot on plums will also be manifest by the rotting and the frequent massing together of two or three fruits. These plums, either now or later, produce concentric rings of spores, and may either fall off or, more frequently, remain on the trees and dry up. Little can be done at this season beyond removal and destruction of the dressed fruit; if such fruit is left on the tree it dries up and remains for the winter, only to produce a fresh crop of spores, and so reinfect the young growth in the following season. Apples may also be found affected

by this disease, and the same remarks apply to this fruit. Occasionally, instead of the apple rotting and producing its concentric layers of spores, it becomes dark and purple in colour and then dries up. Such fruit, which is usually found amongst stored apples, will, however, produce spores later when conditions are favourable.

Where *Codling Moth* is present, as will be noted by apples falling prematurely and being found "maggoty," the windfalls should be collected or pigs turned in where possible. Haybands should be placed around the trees so that the caterpillars, which are pinkish in colour, may pupate beneath their shelter. Later in the season the whole may be burned. (See Leaflet No. 30.)

Cereals.—Farmers will now find the *Smuts* and *Bunts* showing on their corn, and nothing can be done to check these diseases this season. Every effort should be made, however, to prevent wastage of good corn by such parasites next year. *Bunt* in wheat, *Smut* in oats, and *Stripe* in barley can be controlled by "steeping" the seed. For this purpose the Ministry recommends formalin or copper sulphate (blue vitriol). These substances are by far the most efficient steeping solutions, and should be used in preference to other substances of doubtful value. (See Leaflets Nos. 92 and 328.)

Wheat Bulb Fly has been very destructive to winter wheat this season, and has occurred especially on wheat after bare fallow. Evidence is accumulating to show that the pest is always most serious on land which has been fallow or only partially covered by such crops as potatoes during the latter half of the summer. In the case of fallows, at all events, it is very probable that the trouble may be avoided by sowing such a crop as mustard after the land has been cleaned. The mustard is ploughed in previous to the wheat being sown, and is, of course, a valuable preparation, quite apart from its probable effects against the Wheat Bulb Fly.

THE INJURIOUS APPLE CAPSID . (*Plesiocoris rugicollis*, Fall.).

KENNETH M. SMITH,

Adviser in Agricultural Entomology, Manchester University.

It has long been known that there are several species of bugs belonging to the family Capsidæ which live upon apple trees. These insects feed by means of their long trunks, which they push down into the tissue of leaf and fruit and use also for sucking up the sap. Until recent years the damage resulting from this feeding has been attributed indiscriminately to any of the four or five apple-feeding species, but of late Fryer (1) and Petherbridge (2) have discovered that the damage is due to only one species, a green bug, *Plesiocoris rugicollis* by name. This has been confirmed by the writer in recent experiments.

Nature of Damage.—This bug seems to have increased greatly of late years, and has caused serious losses to apple growers, particularly in Cambridgeshire and the Wisbech district. The damage caused by the insect consists of a stunting of the leaves and shoots, serious malformation of the fruit, and, after consecutive attack for several years, a stunting of the tree itself. In the case of the leaf, wherever *P. rugicollis* inserts its rostrum and sucks the sap, there appears a red spot which may spread somewhat and which represents an area of dead cells. The young leaves and shoots are generally chosen, and in a severe attack the young foliage is almost entirely covered with these red spots, and in many cases growth ceases and the shoots are killed. As the young apples appear the capsids transfer their attentions to this fruit, and the apples in their turn become covered with the characteristic red spots. The only difference in this case is that the damage develops further, a corky scab is formed, growth of the apple ceases, and frequently the fruit falls to the ground. In cases where only one side of an apple is punctured, the undamaged side continues to grow, and a badly distorted and unmarketable fruit is the result. In bad cases of capsid attack the damage to the fruit is very similar to, and sometimes mistaken for, the fungal disease, apple scab. The object of the work here described in brief was to ascertain the nature of the damage and the reason that only one species produced it.

Experiments as to the Cause of Damage.—There are three possible explanations of this damage—(1) a purely mechanical

laceration of the tissue by the mouthparts of the bug in the process of feeding; (2) the introduction into the plant of bacteria along with the salivary juices, which then set up a disease; (3) the introduction into the plant of some chemical substance or enzyme, which causes a reaction with the juices of the plant. A number of experiments were performed to ascertain which of these theories was the correct one.*

The results of these experiments proved conclusively that the damage was caused by some chemical substance or enzyme in the salivary juices of *Plesiocoris rugicollis* peculiar to this species among those bugs normally feeding on apple. This chemical substance or enzyme is injected into the juices of the apple along with the secretion from the salivary glands, and sets up the violent reaction above described.

Lygus pabulinus.—There is another green bug of the same family, and closely allied to *P. rugicollis*, namely, *Lygus pabulinus*, which normally feeds upon herbaceous plants, as for instance, potatoes, and the injury it produces affords a parallel case to that caused by *P. rugicollis* on the apple. Although *L. pabulinus* feeds upon potato during the summer, in the early part of the year it lives upon red currant and gooseberry, from whence it migrates to the potato, and in late autumn turns its attention to the artichoke. The writer has found it upon red currant, black currant, gooseberry, pear, potato, bindweed, dock, plum, among other plants, and under experimental conditions has reared it to adult life from the first stage (or instar) upon apple and willow, the two food plants of *Plesiocoris rugicollis*. These facts are mentioned in order to show the danger to be apprehended from this family, consequent upon the changing of the host plant. The reasons for these changes of food plants are not known, but it would be well to recognise the possibility of capids such as *Lygus* and its allies suddenly developing a taste for fruitarian diet.

Further information as to the life history and control of the Apple Capsid is given in the Ministry's Leaflet No. 319. The following methods of control of this insect are recommended in the leaflet:—

Methods of Control.—Apple Capsids are difficult insects to control, but the damage can be greatly reduced by careful spraying. The work, however, must be well done, for it is necessary to wet each bug with the spray fluid—not an easy matter when they are sheltering between the flower buds in the trusses or among

* For a detailed account of these experiments, see the writer's paper in the *Annals of Applied Biology* of this year.

the developing leaves. Further, a very few bugs are capable of doing great injury, and therefore the majority of the insects must be killed if real benefit is to be gained. A fairly coarse nozzle should be used so as to get a driving spray, which should be directed first downwards into the trusses and leaves of a branch passing from the tip to the trunk, and then back again to the tip after turning the nozzle upwards, so as to catch bugs sheltering underneath the leaves.

The best time to spray varies with the season, but it is generally during the week or ten days immediately preceding the bursting of the blossom. A watch should be kept for the first signs of spotting of the leaves—then, after an interval of ten days to allow the majority of the bugs to hatch, the spray should be applied. Much good can be done by one spraying, but in a badly affected orchard, especially if a good crop is anticipated, it is better to spray again immediately after the petals have fallen.

The best insecticide to use is nicotine, which should always be combined with soap or paraffin emulsion to assist it to run freely in the trusses and between the young leaves. The following formula has proved satisfactory :—

Nicotine (98-99 per cent.)	..	..	..	3 oz.
Soft soap	..	..	..	4 lb.
Water	..	..	..	40 gal.

This wash is, of course, expensive, but it is waste of labour and time to spray against Capsids with a wash which is not highly efficient. Further, nicotine and soap will kill aphides, apple suckers, and a good proportion of any winter moth caterpillars which may be present, and it is therefore a good "general purpose" spray.

References.—(1) Fryer, J. C. F.—Preliminary Notes on Damage to Apples by Capsid Bugs. *Annals of Applied Biology*, Vol. I., No. 2, July, 1914.

(2) Petherbridge & Husain.—A Study of the Capsid Bug found on Apple Trees. *Annals of Applied Biology*, Vol. IV., No. 21, March, 1918.

THE GREAT EASTERN RAILWAY DEMONSTRATION TRAIN.

THE Great Eastern Railway Company have recently shown great enterprise in arranging for a Demonstration Train to be run over their railway with the object of instructing growers and allotment holders in the Eastern Counties of England in up-to-date methods of production of crops, poultry and small live stock. This is not the first enterprise of the kind undertaken by the Company; a train was equipped some years ago for the purpose of stimulating egg production in the district served by the Railway. The results of this earlier experiment were such as, in the opinion of the Company, would justify the cost of the undertaking, and they therefore decided to run a second train containing exhibits which would include, in addition, the subjects of horticulture and live stock.

Training and Itinerary.—The Train consisted of three converted hospital coaches, a restaurant car and a van. It started from Liverpool Street Station on 17th May, after an official opening by the Parliamentary Secretary of the Ministry, Sir Arthur Griffith Boscawen, M.P., and ended its journeyings at the same station during the first week in July. The itinerary of the train included Essex, Suffolk, Norfolk, Cambridgeshire, Huntingdonshire and Lincolnshire. Forty stations were visited, and the general rule was for the train to be in its place and ready for inspection by visitors at 1 p.m. on the date fixed, and to be open until 8.30 p.m. During this period a constant stream of visitors passed through it, examining the items on view. It is estimated that up to the 14th June, 77,500 persons had visited the train.

The success of the Train was assured from the first, as is well testified by the large numbers of people who took the opportunity of visiting it. The Train as a whole was in charge of officials of the Great Eastern Railway Company, who made all arrangements.

One of the cars was placed by the Company at the disposal of the Ministry for the purpose of placing on view exhibits bearing on horticulture, fruit preserving and dairy produce. This car was staffed by officials of the Ministry.



FIG 1.—Exterior of Train at Stratford Station



FIG. 2.—Portion of Poultry Section Exhibit.



FIG 3.—Horticultural Car—Fruit Bottling and Canning Section.

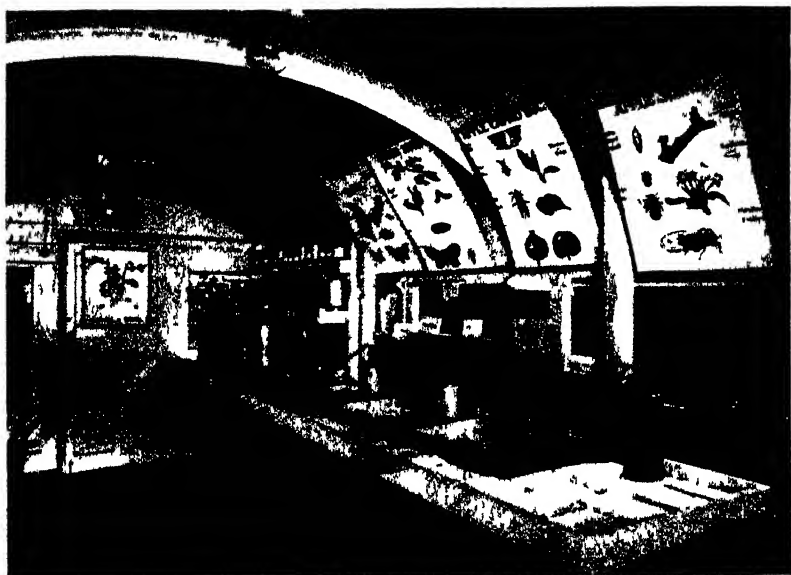


FIG. 4.—Horticulture—Pests and Spraying Section.

The Staff.—All the demonstrators on the Train were carefully selected as practical men with experience in dealing with their subjects. Mr. J. N. Leigh, the poultry expert of the Great Eastern Railway Company, was present to give advice on poultry, and he was assisted by Mr. Tom Barron and others.

As regards horticulture, the Ministry placed at the disposal of the Railway Company Mr. Vincent Banks, whose work in dealing with the preservation and bottling of fruits and vegetables is so widely known throughout the country. His demonstrations were thoroughly appreciated by all visitors interested in horticulture. Mr. Jenkins advised small cultivators on the growing of garden and allotment crops, fruit culture, the management of bees, and bee-keeping. Mr. C. H. Middleton advised fruit growers on matters relating to fruit culture, including measures for the control of pests. These experts travelled with the Train to explain the exhibits, answer questions, and give advice generally. The subjects treated were soil working on small holdings and allotments, liming, manuring, fruit and vegetable growing, insects, and small live stock.

The Exhibits.—The Ministry's exhibits may be divided into four sections, representing (1) Fruit and Allotment Culture (including a small Bee Exhibit, (2) Plant Diseases, (3) Fruit and Vegetable Preservation, and (4) Dairying.

(1) *Fruit and Allotment Cultivation and Bee-keeping.*—Fruit growers showed great interest in the specimen fruit trees (growing in pots) which were employed to demonstrate the best methods of grafting and pruning. The specimens were supplemented by photographs of large trees showing the ultimate benefits accruing from such methods. Attention was directed to the suitability of the bush type of tree for cottagers and small growers. Allotment holders were provided with photographs, charts, and descriptive diagrams of model allotments, and examples of the best tools and implements for their use were exhibited.

The great interest now taken in bee-keeping was shown by the numerous inquiries on this subject, and numbers of people appear to wish to make a start in bee-keeping.

(2) *Plant Diseases.*—Allotment holders and fruit growers had a common interest in the Plant Disease Exhibit, and even the casual passer-by was attracted by both specimens of the many pests of the farm and garden. The various methods of attacking these pests were illustrated by diagrams

and explained in leaflets, while samples of washes and spraying machines and specimens of such natural enemies to the pests as the ladybird were also shown.

Inquiries concerning many of the common pests were numerous, and in many cases specimens were brought for identification and advice. Special interest was aroused by the specimens of potatoes infected with Wart Disease. This disease, extremely common in the western and northern districts is rare in the eastern counties, and growers were glad of the opportunity afforded of seeing examples, which would enable them to recognise the disease should it appear in their gardens. It may be mentioned, however, that every effort is being made by the Ministry to keep these counties clear of the pest. Another disease which has recently been made the subject of an Order of the Ministry is a new disease of onions, called Onion Smut, and the specimens of onions infected with this disease were also on view.

(3) *Fruit and Vegetable Preserving*.—Perhaps the most striking exhibit in this car was the display of bottled fruits and vegetables, containing produce which in some cases had been preserved by simple methods for several years, and was still in excellent condition. The apparatus shown included various types of bottles, cans, ovens and sterilisers, and frequent demonstrations were given in their use. Simple methods of fruit and vegetable drying, methods of canning, and the preservation of stone fruit by means of sulphur fumes, were also shown. Visitors were frequently surprised at the easy nature of these operations and the simplicity of the apparatus required, and there is no doubt that as a result of these demonstrations fruit which might otherwise have been wasted owing to the scarcity of sugar this season will now be preserved.

(4) *Dairying*.—The dairy expert gave practical demonstrations in cheese-making. All kinds of small cheeses were made from time to time; and the demonstrator showed that the quick production of a small cheese was a good way of using up a quart of milk. Larger cheeses were also made as opportunity offered.

(5) *Poultry and Small Live Stock*.—The poultry section pleased a large section of the visitors, and there were always large numbers to listen to the 10-minute lectures on the various subjects, including a lecture on "How to choose a hen for laying purposes." The aim was to bring to the notice of the small poultry keeper the best breeds and the best system of feeding to improve the standard of egg production.

Although rabbits are not now kept to the same large extent as during the War, there are still many people interested in rabbit keeping, and the different breeds and specimens of skins made up into various kinds of fur were represented on the Train. The possibilities of rearing Chinchilla, Havana, Blue Beveren, and other breeds for their pelts was pointed out. The demonstrators gave the fullest information, not only as to the best means of starting rabbit keeping but also of disposing of the produce.

From time to time there has been much controversy as to the value of goats. Advocates of the keeping of the "poor man's cow" have been many, and those interested had the opportunity of listening to lectures on goats and their value. Two goats were carried on the Train in order to enable the lecturer to demonstrate his points in a practical manner.

REDEMPTION OF TITHE RENTCHARGE :

THE TITHE ACT, 1918—INCOME TAX LIABILITY OF LANDOWNER AND TITHEOWNER.

(1) **Introduction.**—Leaflet No. 329 issued by the Ministry detailed the procedure for the redemption of tithe rentcharge under the provisions of the Tithe Act, 1918. A redemption of tithe rentcharge will, however, generally entail modifications of the Income Tax liability of both the titheowner and the landowner who has redeemed the rentcharge, and this supplemental leaflet, which has been prepared in conjunction with the Commissioners of Inland Revenue, is intended to explain the modifications that will be necessary.

(2) **The Present Method of Assessing Tithe Rentcharge to Income Tax.**—(a) The usual practice is for the owner of a number of tithe rentcharges arising out of property in any one parish to return them all for assessment upon himself in one sum.

(b) In the exceptional cases, however, where the titheowner does *not* make a return for the assessment of the tithe rentcharge upon himself for the payment of Income Tax, the land out of which the tithe arises is assessed inclusive of the tithe (as explained in paragraph 3 (b)), and the landowner deducts Income Tax from the tithe as and when he pays it to the titheowner.

(3) **Tithe Rentcharge as affecting the Landowner.**—(a) Where the landowner pays out of the rent received for a particular property a tithe rentcharge to a titheowner who returns the same for direct assessment, as explained in paragraph 2 (a), a deduction in respect of the tithe rentcharge is made from the rent when assessing the property to Income Tax under Schedule A. Thus, if the landowner in such a case lets a farm for a rent of £200 per annum, and out of the rent pays a tithe rentcharge of £20 per annum, he would be assessed upon £180 only.

(b) If, however, the titheowner were *not* directly assessed for the tithe rentcharge, the landowner would be assessed upon the full rent, £200; but as he would have the right to deduct tax from the tithe, £20, upon payment—as explained in paragraph 2 (b)—he would ultimately bear tax upon £180 only.

(4) *Effects of Redemption of Tithe Rentcharge upon Income Tax Liability.*—Leaflet No. 329 sets out the two alternative methods of redeeming a tithe rentcharge, viz., (I.) by payment of a lump sum, and (II.) by payment of an annuity.

I.—*Redemption by payment of a lump sum.*—If the titheowner has been assessed directly in respect of his tithe rentcharge, his position after the redemption will be that his income from this particular source has diminished. He will, therefore, be entitled to a proportionate reduction of the total gross assessment upon his tithes, subject to a proportionate reduction also of the deduction allowed from such assessment in respect of rates, land tax and cost of collection. The landowner, on the other hand, will after the redemption no longer be under the necessity of paying the tithe rentcharge redeemed. He has, however, previously received for assessment purposes a deduction in respect of this tithe (*vide* paragraph 3 (a)), and such deduction will now fall to be withdrawn.

If the titheowner has *not* been directly assessed for the tithe rentcharge, the effect of a redemption will be merely to diminish the amount of income which he receives under deduction of tax (*vide* paragraph 2 (b)). The landowner being no longer under obligation to pay tithe rentcharge out of his rent will, in future, himself bear the tax which he formerly recovered from the titheowner (*vide* paragraph 3 (b)).

II.—*Redemption by payment of an annuity.*—Where redemption is effected by payment of an annuity, the titheowner, if assessed directly for the tithe rentcharge, will be entitled to apply for a reduction of his total assessment for tithe as explained under (I.) above. Such portion of the annuity as represents interest upon the consideration money will be received under deduction of tax, but tax will not be payable on the residue of the annuity. As regards the landowner, inasmuch as he will be relieved of any further payment of tithe rentcharge he will no longer be entitled to the deduction hitherto allowed him, as explained in paragraph 3 (a) above. He should, however, *clearly understand that he is entitled to deduct Income Tax from such portion of the annuity as represents interest upon the consideration money* (*vide* Leaflet No. 329, paragraph 6).

If the titheowner has *not* been directly assessed for the tithe rentcharge, he will after the redemption be receiving interest upon the consideration money, taxed by deduction, in place of tithe rentcharge taxed by deduction. The landowner, on the other hand, will be paying interest from which he is

entitled to deduct tax upon payment, in place of a tithe rentcharge from which he was similarly entitled to deduct tax.

Any titheowner or landowner who desires further information respecting the effect of redemption of tithe rentcharge upon Income Tax Liability, or who desires an amendment of an Income Tax assessment in consequence of such a redemption, should communicate with H.M. Inspector of Taxes for the District embracing the parish in which the property out of which the tithe rentcharge issues is situated. The address of H.M. Inspector of Taxes can be readily ascertained from the local Collector of Taxes. Inquiries relative to the provisions of the Tithe Act, 1918, itself, or to the method of redeeming a tithe rentcharge, must not be addressed to H.M. Inspector of Taxes, but to the Ministry of Agriculture and Fisheries, 3, St. James's Square, London, S.W. 1.

(Copies of this Article in the form of Leaflet No. 348 may be obtained gratis and post free on application to the Ministry.)

AGRICULTURE ABROAD.

AN event probably of some significance in augmenting the friendship between two already friendly nations was associated with the recent Horticultural Exhibition at Antwerp. The British exhibit, arranged and carried out at short notice, was at once beautiful and striking, and the circumstances attending the inception and execution of this scheme are of peculiar interest to horticulture. At the request of the Belgian Foreign Office the Ministry of Agriculture invited the British Chamber of Commerce to organise a collective display of British-grown fruit and flowers for the Antwerp Exhibition. The Chamber immediately agreed and sent a representative over to Antwerp to interview the Exhibition Committee and obtain particulars. The result of his inquiries was that the Chamber took over the entire space of the Central Hall, an area measuring 135 ft. by 35 ft.

On the Thursday and Friday immediately before the opening eight members of the British Chamber went over to Belgium with two truckloads of cut flowers, orchids on roots, fruit and plants. During Friday, Friday night and Saturday morning the representatives worked at high pressure arranging their specimens in the form of a garden and turfing over the remainder of the allotted space. They produced an exhibit that was generally acknowledged to be an example of taste and beauty, apart from any question of the excellence of the specimens shown. On the Sunday H.M. King Albert opened the Exhibition and began his tour of the Hall by spending nearly forty minutes with the British representatives. The King asked many questions about cultivation, the area of nurseries, the position of British labour, and kindred topics. He laid special stress on the thanks that were due to British horticulturists for the exhibit, and more than once expressed his opinion that it was calculated to improve the relations between the two countries.

The representatives of the British Chamber were asked to assist in judging the foreign exhibits. It goes without saying that they took no part in awarding prizes to British competitors. The collective British exhibit received from the Belgian judges the highest possible award, and two other highest awards went to individual sections. The President specially commended the quality and excellence of the British flowers, the style and arrangement, and the assistance which British horticulturists had lent to the whole Exhibition. On the

evening of the opening day the Chairman of the British Chamber of Horticulture (Mr. Munro), in return for Belgian hospitality, invited the officials to dinner. The Belgians treated the matter as an official affair, as the British exhibit had been made at the request of a Ministry. Among those present were General Cabra, the Governor of the Province of Antwerp, the Burgomaster of the City, and some thirty of the higher Government and Municipal officials. The General, the Governor, the Burgomaster and many others made speeches dwelling on the importance of the British horticulturists' visit and its effect in drawing the two countries closer together.

The following morning the British Consul, acting under the instructions of our Ambassador, called on Mr. Munro and expressed similar sentiments.

Next autumn it is proposed to arrange a similar exhibit. The whole Exhibition was designed to form a garden scene, to which the British contribution lent the most charming touch. About 10,000 carnation blooms were displayed in vases and stands and grouped in beds set in a grass lawn. Two corner beds were filled with carnations and orchids. Choice roses—Richmond, Alberta, Madame Abel Chatenay and Molley Sharman Crawford—were shown in huge baskets, each group forming a distinct feature. In the central beds heaths and marguerites were set out, and in others were baskets filled with cucumbers, tomatoes, melons, apples, figs, peas and beans. The Belgian exhibits contained collections of Indian and Mollis azaleas, rhododendrons, orchids, araucarias, acacias, and other plants. A notable feature was the exhibit of giant palms and bay trees, which gave the whole Exhibition a sub-tropical effect. There were also several wonderful examples of landscape gardens. The whole undertaking was not only stimulating to horticulture, but was a factor in demonstrating international concord. The fashion here inaugurated is likely to be continued with valuable results during the whole series of flower shows, which will form the main features of the Antwerp fêtes from now until the end of October.

* * * * *

It appears from a note published in the issue of the *International Review of Agricultural Economics* for April last that certain railway companies have given valuable assistance in promoting the development of agriculture in France. Their activities have consisted mainly in the distribution of seed and plants, introducing new varieties, and holding competitions with a

**Railway Companies
and Agricultural
Production in
France.**

view to encouraging the more extended use of agricultural machinery and fertilisers.

Their efforts, however, have not been confined only to the technical side of agriculture. Much has apparently also been done, no doubt with a business eye, for promoting the commercial side of the industry. Parties consisting of agents of the railway companies and of specially qualified farmers were arranged to visit certain areas, both in France and other countries, for the purpose of studying the state of the markets with reference to such produce as corn and root crops, live stock, early vegetables and flowers. Reports were then drawn up, for the information of the farmers of the home districts, describing the conditions prevailing in the areas visited. These reports, it was hoped, would be of assistance to farmers in directing them in the cultivation of crops which would be likely to be most profitable. Further, the agents and inspectors of the companies' commercial departments made individual inquiries or were delegated to make investigations as to the fluctuations of the markets over periods of several months. Large numbers of pamphlets were circulated among farmers, giving information which would help to direct them in their operations.

A further action on the part of the railway companies to improve the facilities for the distribution of agricultural produce was the formation of producing and selling co-operative societies. By this means isolated farmers in the more remote country districts were enabled to get into direct touch with French and foreign consumers.

* * * * *

ACCORDING to a note published in the issue of the *Board of Trade Journal* for the 20th May last, a South African Cattle Breeders' Association is to be organised as the result of a resolution passed recently at a representative meeting of South African cattle breeders in Johannesburg. Under the terms of the resolution, the Association is to frame and observe a uniform policy in the handling, marketing, and exporting of cattle and their products, and generally to do all that may be necessary for the protection of cattle breeders, for the expansion of the cattle-raising industry to their advantage and profit, and in the interests of the consuming public.

South African breeders feel that there is an opportunity at the present time to raise the quality of South African beef in the world markets. Organisation is considered to be

necessary to improve the present strain. It will then be possible to establish in South Africa the nucleus of an industry which may take a leading place in international trade.

* * * * *

ONE of the problems which requires to be settled in Northern France is the replacement of the live stock which has been destroyed by the ravages of the late War.

**Live Stock for
Devastated Areas
in France.**

It was stated in a note in the issue of the *Journal d'Agriculture Pratique* for 22nd April last that, in accordance with the terms of the Peace Treaty, the devastated areas of France are to receive from Germany 500 stallions, 30,000 horses or mares, 2,000 bulls, 90,000 milch cows, 1,000 rams, 100,000 sheep, and 10,000 goats. Convoys of this stock have been arriving since the second week of March, and by the 1st of April, 1,400 horses, 4,000 cattle, 10,000 sheep and 4,000 goats had been delivered. Although, according to the note, the agriculturists of the liberated areas had so far been quite satisfied with the quality of the stock received, there was some anxiety felt as to the state of their health on account of the prevalence in Germany of foot-and-mouth disease. In view of the prevalence of this disease in France as well, however, it was considered by the authorities concerned that no more danger was incurred by receiving the German cattle than by buying stock at the local fairs and markets. Moreover, the financial loss which might be entailed by outbreaks of the disease in the imported cattle was probably much less than would result if the importation of German cattle was discontinued.

ACCORDING to information recently communicated to the Ministry from America, experiments have been conducted

**Mineral Matter
and Milk.**

by the Bureau of Animal Industry and the Department of Agriculture of the United States Government with dairy cows, which indicate an important relation between milk secretions and certain mineral substances. The results suggest that feeding compounds of phosphorus and calcium have a decidedly beneficial effect on the milk flow, both in quantity and fat content.

It has also been found that a deficiency of phosphorus in the dairy rations has a detrimental effect on milk secretions of cows and on the growth of calves. This deficiency was successfully remedied, however, by the addition of sodium phosphate to the rations.

NOTICES OF BOOKS.

Journal of the British Dairy Farmers' Association. Vol. 32 (London: McCorquodale & Co., Ltd., 1920, 3s.)—This publication, which reappears after an interval of three years, contains several valuable articles, of which two in particular are of special interest at the present time. In a critical discussion on "Some Effects of the War on the Dairying Industry," Mr. Primrose McConnell, B.Sc., F.G.S., examines the present difficult position of dairy farmers in this country. While offering several helpful suggestions, he sees little prospect of a general improvement without a complete change in the present unsympathetic attitude of the community towards the industry. Supplementing this article to some extent is a careful study of dairy farming in Switzerland, the result of a three months' visit to that country last year by Mr. James Long. In suggesting several features of the Swiss system which might usefully be adopted in this country, he emphasises especially the Swiss practice of using upland pastures for grazing purposes.

Among other contents is a full record of the Dairy Show, which was revived last year after an interval of several years necessitated by the War. Special reports are given on the milking trials and butter tests at the Show.

Gloucestershire Cattle Society.—Report and Herd Book, 1919 (Gloucester: Crypt House Press). This is the first annual report of the newly-formed Gloucestershire Cattle Society, which has for its object the improvement of the Gloucestershire breed of cattle. During the past century the breed had become almost extinct, but the Society confidently expects that the fine specimens which still remain will form the nucleus of herds that will be known all over the world. Fourteen herds have been visited, and 130 animals registered in the Herd Book, 14 being bulls and 116 cows.

The following are indicated as the points (primary and secondary) of the Gloucestershire Breed of Cattle.—

Primary.

- Body, black brown.
- Head and legs, black.
- Dark muzzle and dark roof of mouth and top of tongue.
- Cow's horn, fine with black tip, wide and inclined to turn up.
- White tail, long hair or brushy.
- White streak on back.
- Thin yellow skin with fine short hair.
- White belly.
- Black or spotted teats.
- Broad forehead, long and Roman nose.

Secondary.

- Thin neck.
- Ears large and hairy.
- Shoulders fine.

The Society encourages milk recording—a practice that the Ministry of Agriculture recommends should be done by every dairy.

QUESTIONS IN PARLIAMENT.

Foot-and-Mouth Disease.—In reply to a question by Captain Coote, the Parliamentary Secretary to the Ministry stated that the Ministry was aware that in a few cases individuals would prefer to run the risks involved by an outbreak of foot-and-mouth disease rather than have their stock slaughtered, but the general opinion of agriculturists was strongly on the side of the policy of stamping out adopted by the Ministry, as may be seen from the Report of the Departmental Committee on the subject in 1912. The disease was not directly dangerous to the public health, and, as a rule, horned stock would recover from it; but the disease was highly contagious, and any widespread outbreak might have a serious effect upon milk production. In certain cases where the circumstances were favourable the Ministry had successfully carried out a policy of isolation, but such a method was rarely applicable because of the lack of suitable accommodation on the ordinary farm, and would not be effective as a general policy. As a rule, an outbreak was detected at an early stage, and it was more economical for the industry as a whole to proceed to slaughter than to attempt a system of isolation, especially in view of the fact that the export of pedigree stock to foreign countries, which was a very valuable trade, was seriously hampered so long as foot-and-mouth disease existed in this country. The policy of the Ministry had been completely successful in checking the spread of the disease in the numerous outbreaks that had occurred of late, and had earned for the Ministry the thanks of the farmers in the districts affected. (28th June, 1920.)

Pig-Keeping.—In reply to a question by Sir Beville Stanier, the Parliamentary Secretary to the Ministry stated that the Ministry of Agriculture and Fisheries Act, 1919 (Section 8, Sub-section 4) provided that County Agricultural Committees should make such inquiries as they considered desirable with a view to formulating schemes for the development of rural industries and social life in rural places. The Ministry had formed a Rural Industries Branch under the direction of Sir John Green. Active steps were being taken to encourage and to revive the keeping of pigs and other small live stock among cottagers, and no less than 123 mutual clubs or societies for the purpose had already been formed. The question of insurance of live stock by cottagers had been investigated, and rules for the mutual insurance of pigs and cows had been printed and circulated. Grants from the Development Fund had been given to the Federation of Women's Institutes and to the Village Clubs Association for the purpose of assisting the establishment of women's institutes and village clubs. (28th June, 1920.)

Wheat Prices.—In reply to a question by Mr. McNeill, the Parliamentary Secretary to the Ministry stated that the figure of 68s. per qr. for wheat was the amount which in the opinion of the Royal Commission on Agriculture represented the average bare cost of production in 1919, including interest on capital or remuneration to the farmer himself. The Commission in its report stated that it arrived at this

figure after considering a large body of evidence as to the actual cost of production in 1918, and then applying to its estimate of the average cost in that year the increase which the evidence indicated to have taken place between 1918 and 1919, disregarding any variation in rent. The Report of the Commission did not give detailed figures distinguishing the various items in the cost of production, such as labour, but it referred to the fact that wages had advanced in most parts of the country beyond the minimum rate of 36s. 6d., and that the hours in respect of which the minimum rates were payable had been reduced. (10th June, 1920.)

In reply to a question by Mr. Lane-Fox, the Parliamentary Secretary to the Ministry stated that the average (c.i.f.) price of wheat imported into this country has been as follows :—

	<i>s. d.</i>		
1917	91	6	per 480 lb.
1918	100	10	" " "
1919	92	1	" " "
1920 (Jan.—May) ..	95	0	" " "

The corresponding price for 1916 cannot be given, as control did not commence until 11th October, 1916.

The price of British wheat was subject to no control until 16th April, 1917, when a maximum price of 78s. per qr. of 480 lb. was fixed for wheat harvested in 1916. On 14th August, 1917, the following maximum prices were fixed for wheat harvested in 1917 :—

Where delivery was to be made before 1st December, 1917, 73s. 6d. per qr. of 504 lb. (70s. per 480 lb.).

Where delivery was to be made in December, 1917, or January, 1918, 74s. 6d. per qr. of 504 lb. (70s. 11d. per 480 lb.).

Where delivery was to be made in February or March, 1918, 75s. 6d. per qr. of 504 lb. (71s. 11d. per 480 lb.).

Where delivery was to be made in April or May, 1918, 76s. 9d. per qr. of 504 lb. (73s. 1d. per 480 lb.).

Where delivery was to be made on or after 1st June, 1918, 77s. 9d. per qr. of 504 lb. (74s. 1d. per 480 lb.).

On 31st August, 1918, the following maximum prices were fixed for wheat harvested in 1918 :—

Where sale was made before 1st January, 1919, 75s. 6d. per qr. of 504 lb. (71s. 11d. per 480 lb.).

Where sale was made in January, February, or March, 1919, 76s. per qr. of 504 lb. (72s. 5d. per 480 lb.).

Where sale was made on or after 1st April, 1919, 76s. 6d. per qr. of 504 lb. (72s. 10d. per 480 lb.).

There was no maximum price for wheat harvested in 1919, but millers were informed by the Food Controller that the prices to be paid by them should not exceed an average of 76s. 6d. per qr. of 504 lb. (72s. 10d. per 480 lb.) for wheat purchased on rail at producer's station, or 77s. per qr. of 504 lb. (73s. 4d. per 480 lb.) for wheat delivered into mill. (14th June, 1920.)

Prices of Wheat and Oats.—In reply to a question by Major Barnes, the Parliamentary Secretary to the Ministry stated that the relative prices of wheat and oats in 1913 and in 1919 were as follows :—

—	WHEAT.		OATS.			
	Price per Imperial Qr. of British Wheat.	Quantity produced in United Kingdom.	Imports (including flour in equivalent wt. of grain).	Price per Imperial Qr. of British Oats.	Quantity produced in United Kingdom.	Imports.
1913	s. d.	qr.	qr.	s. d.	qr.	qr.
1919	31 8 72 11	7 087,000 8,665 000	28,587 000 22 401,000	19 1 52 5	20,660 000 25,495,000	6,520,000 2,409,000

(7th June, 1920.)

Councils of Agriculture.—In reply to a question by Sir K. Wood, the Parliamentary Secretary to the Ministry stated that the Councils of Agriculture would be established as soon as possible after the County Agricultural Committees, now being sent up by each County Council in England and Wales, had appointed their two representatives. It was hoped that this would be done at the first meeting of each Committee, but as in many instances the County Committee had not yet been fully constituted, it was impossible to say definitely when the Agricultural Councils would be formed. It was hoped, however, that the Councils would be constituted in time for the first meetings to be held next November. (9th June, 1920.)

Home Grown Sugar.—In reply to a question by Mr. C. White, the Parliamentary Secretary to the Ministry stated that the company known as Home Grown Sugar, Ltd., was registered on the 13th February, 1920, with a nominal capital of £1,000,000, divided into 1,000,000 ordinary shares of £1 each. The Government agreed to subscribe for a number of ordinary shares (not exceeding 250,000), equivalent to the number of allotted to public subscribers. The total number of shares issued by the company was 500,000, of which 250,000 had been allotted to the Government. No shares had been allotted otherwise than for cash. The Government had guaranteed a dividend of 5 per cent. per annum upon the capital subscribed by the public up to 250,000 shares for the period ending 31st March, 1930. The directors might, at any time after repayment to the Minister of Agriculture of any sum paid to the company, call upon the Minister to sell his shares upon payment of their par value, together with a deferred dividend of 5 per cent. upon such shares as from the date of allotment.

The remuneration of the Directors, other than the Managing Directors, was at the rate of £300 per annum for each Director, and an additional sum of £100 per annum was paid to the Chairman for the time being of the Board of Directors. The Government had no voice in the appointment of Members of Parliament as Directors. The Minister of Agriculture was, however, entitled to appoint a Director of the Company to act as the Government's financial representative, and such financial

representative had been appointed. The Directors' fees are paid by the Company, but the fees of the financial representative were paid over to the Ministry, and the financial representative was paid an equivalent amount by the Ministry in place of receiving his remuneration direct from the Company. (8th June, 1920.)

Calf Breeding.—In reply to a question by Captain Terrell, the Parliamentary Secretary to the Ministry stated that while the Ministry was not taking any special steps to stimulate the raising of calves, the provision of bulls under the Live Stock Scheme encourages indirectly the rearing of calves, as on the information before the Ministry practically all the heifer calves and the majority of the bull calves that were bred from subsidised sires were reared in consequence of their higher value. It was to be regretted that large numbers of calves bred in dairying districts were not fit to rear owing to the fact that many dairy farmers made use of badly-bred bulls. It was hoped that when meat was de-controlled next month* there would be greater inducement to rear calves. (16th June, 1920.)

The King's Premium for Stallions.—In reply to a question by Sir R. Newman, the Parliamentary Secretary to the Ministry stated that of the 60 stallions which were awarded King's Premiums this season, 53 had been raced and 36 of them were winners. In their award of premiums the judges take into consideration a stallion's turf record, and with this object in view they were furnished by the Ministry with particulars of the racing performances of all the horses exhibited for premiums. (7th June, 1920.)

The Agriculture Bill and Nursery Gardens.—In reply to a question by Mr. A. Samuel, the Parliamentary Secretary to the Ministry stated that although the occupiers of nursery grounds had to pay their employees the minimum wages prescribed by the Agricultural Wages Board, nursery grounds did not come within the definition of a holding in the Agricultural Holdings Act, and consequently the occupiers could not obtain the compensation provided by the Act for tenants of agricultural holdings or market gardens. It appeared to the Ministry that it would be difficult to justify the extension of the scope of the Agricultural Holdings Act so as to include nursery grounds, and he was not prepared, therefore, to propose an Amendment to the Agricultural Bill to that effect. With regard to the point as to the payment of minimum wages, it seemed obvious that occupiers of nursery grounds could not reasonably expect to pay wages which are less than minimum wages fixed for agricultural labourers. (16th June, 1920.)

Hay and Straw Department, War Office.—In reply to a question by Sir A. Williamson, the Parliamentary Secretary to the Ministry stated that the Forage Department of the War Office was being wound up, and would cease to exist at the end of the present month. The Department occupied one office only with a small staff, which was daily diminishing. (9th June, 1920.)

Agricultural Organisation Society.—In reply to a question by Mr. Robert Young, the Parliamentary Secretary to the Ministry stated that during the financial year 1919-20, grants paid to the Agricultural Organisation Society from the Development Fund and the Ministry amounted to £45,600. In addition, a loan of £15,000 was issued to the

* Control of Meat ceased on 4th July, 1920; see note on p. 399.

Society from the Development Fund. The organising was done by paid organisers, but a large amount of voluntary assistance was also given. The salaries and expenses of the staff amounted to £27,810, and £9,462, respectively; of these amounts approximately four-fifths were met by the Government grants. The amount of affiliation fees paid during the year was £6,990. The number of societies which paid fees was 1,074. (9th June, 1920.)

Agricultural Societies.*—In reply to a question by Mr. R. Young, the Parliamentary Secretary to the Ministry stated that he had no precise information as to the membership of the *National Union of Allotment Holders*. The General Secretary of the Union had, however, furnished him with the following statement:

"The Federations, Associations and Societies affiliated to the National Union direct and through such bodies as the Vacant Land Cultivation Society and the London, Southern, Yorkshire, Welsh, North-Eastern, North-Western, Midland and South-Western Sections, represent a membership of 250,000."

"The number of single societies or groups, and societies which come *via* sections and federations was, 1,050. This number represents an advance of roughly 450 societies since last year. Included are federations and societies which have formally decided to affiliate, and which do not pay fees for some little time yet. Everyone affiliated through a federation, association, or society pays a fee. Our year commenced three months ago, and the various affiliated bodies are now collecting their members' contributions."

With regard to the *Agricultural Organisation Society*, he stated that the number and membership of the societies which had paid affiliation fees to the *Agricultural Organisation Society* for the year ending 31st March, 1920, was as follows:—

		<i>Farmers' Societies.</i>	<i>Allotment and Small-Holding Societies.</i>
Number	.. .. .	290	784
Membership	.. .. .	65,500	101,000

These figures did not include the whole of the societies affiliated to the *Agricultural Organisation Society*, inasmuch as there were a number which, for one reason or another, were in arrears with the payment of affiliation fees. They were now being pressed to pay up their arrears on penalty of dis-affiliation. If these societies were included and account taken of the fact that the affiliation fees for 1919-20 were based on membership as disclosed by the Annual Return for 31st December, 1918, the total membership of societies affiliated to the *Agricultural Organisation Society* would be raised to approximately 90,000 farmers and 150,000 allotment holders.

For some time the Ministry had been endeavouring to make arrangements which would prevent any possibility of overlapping between the work of these two bodies. In the course of the negotiations, the *National Union* suggested that the Allotment Sections of the *Agricultural Organisation Society* and the *National Union* should both be wound up, and that a new body representative of all classes of allotment holders should be established. This proposal was carefully considered, but the

* This question was omitted from last month's issue owing to pressure of space.

Minister was unable to adopt it as, in his opinion, it would not be in the best interests of the allotment movement to organise allotment holders entirely apart from all other persons interested in the production of food.

The Ministry submitted, as an alternative, suggestions for delimiting the functions of each body, the principle of which was that, while each association would preserve its present independence, its work for the allotment holder would be complementary to that undertaken by the other association and by the Ministry itself. This proposal, however, had not met with the approval of the National Union, and had, therefore, been abandoned for the present. (11th May, 1920.)

Prices of Sulphate of Ammonia, 1920-21.—The Ministry of Agriculture and Fisheries has come to an agreement with the great majority of the makers of sulphate of ammonia with regard to the maximum prices to be charged for this fertiliser for home agricultural use for delivery in the season 1920-21.

These prices are appreciably higher than those ruling during last season owing to the substantial increases which have occurred since last year in the cost of coal, wages and raw materials. The Ministry considers that these prices are not more than are necessary to secure to the manufacturers a reasonable trade profit.

For sale in lots of not less than 4 tons for delivery by rail or water to purchasers' nearest railway station or wharf in Great Britain, less a trade discount to manure mixers, agricultural merchants, dealers and co-operative societies, the prices are:—

Month of Delivery.	Price per Ton in Bags net Cash.		
	£	s.	d.
July, 1920	23	10	0
August	24	0	0
September	24	10	0
October	25	0	0
November	25	10	0
December	26	0	0
January, 1921	26	10	0
February	27	0	0
March, April and May	27	10	0

In the case of deliveries to Ireland, Isle of Man, or Channel Islands the above prices include delivery f.o.b. port in Great Britain.

Farmers should place their orders without delay with their usual dealer or co-operative society.

Manure mixers, merchants, dealers and co-operative societies should send their orders to the British Sulphate of Ammonia Federation, Ltd., 30, Grosvenor Gardens, London, S.W. 1.

These prices are for sulphate of ammonia containing 20½ per cent. by weight of ammonia. On deliveries of quantities of 2 cwt. or over there are special allowances and extra charges for different analyses, for grinding, for freedom from acid, etc.

The above increases or reductions in the agreed maximum prices chargeable shall not apply to any delivery of less than 2 cwt. of sulphate of ammonia.

For deliveries of less than 4 tons, or for sales of small quantities made at merchant's store, the following additions may be made to the price charged for 4-ton lots :—

<i>Quantity delivered.</i>		<i>Additional Price.</i>
2 tons and over but less than 4 tons		5 0 per ton.
1 ton	2 "	10 0
2 cwt.	1 ton	1 0 per cwt.
1 "	2 cwt.	2 0 "
28 lb.	1 "	3 0 "
14	28 lb.	4 0

In the case of sales for delivery to consumer's premises at merchant's shop or store, the cost of conveyance, charged at local rates, may be added.

Other conditions attaching to the sale of sulphate of ammonia are given in a Circular (F.P. 506/Sr) issued by the Ministry. Copies may be obtained post free on application.

Farmers should experience no difficulty in obtaining prompt delivery of sulphate of ammonia at the above prices. If any such difficulty should arise, the Ministry will be able to arrange for supplies on receiving full particulars, addressed to the Director-General, Ministry of Agriculture and Fisheries, 72, Victoria Street, London, S.W. 1.

Weather Forecasts for Farmers.—The Meteorological Office will, as in past years, supply forecasts of weather by telegraph to persons desirous of receiving them, upon payment of a registration fee of 1s. and the cost of the telegrams, computed at 1s. per message.

The forecasts are drawn up at 10.30 a.m., 4.0 p.m., and 9.0 p.m., (summer time). Forecasts issued at the morning hour refer to the period covering the afternoon of the day of issue and the morning of the following day. Those issued in the afternoon and evening refer to the whole of the following day. All the forecasts include a Further Outlook of the probable weather beyond the 24-hour period whenever such a Further Outlook can be given.

Notifications will also be issued by telegram when conditions indicate that a spell of several days fair weather is likely, and again when the spell is about to break up. For this service a fee of 6d. is charged for telegraphy. A minimum deposit of 5s. against which the charges may be booked is required.

Applications for regular forecasts (as distinct from Spell of Notifications) should specify the hour of the forecasts desired (or hours if more than one telegram daily is required). They should be sent to the Director, Meteorological Office, Air Ministry, London, W.C.2, and should be accompanied by a cheque or postal order payable to the Meteorological Committee to cover the cost of the telegrams for the period during which the forecasts are to be sent.

Further particulars and printed forms of application may be obtained from the Director of the Meteorological Office.

Applications by telegraph for single forecasts shall be addressed to "Weather, London," and the reply should be prepaid.

Regulations for Importation of Hay and Straw.—The Ministry desires to draw attention to the Orders which prohibit the importation of hay and straw from certain countries.

The only countries from which hay and straw may be imported into Great Britain are: The United States of America, the Dominions of

Canada, Australia and New Zealand, the Union of South Africa, Norway, the Channel Islands and the Isle of Man.

Certain exceptions are made in the case of hay and straw in which imported merchandise is packed ; manufactured straw not intended for use as fodder or litter for animals ; and hay and straw authorised to be landed by special licence of the Ministry for use otherwise than as fodder or litter for animals.

Appointment of Controller of Horticulture.—The Minister of Agriculture, Lord Lee of Fareham, has appointed Mr. W. J. Lobjoit, O.B.E., F.R.H.S., to be Controller of Horticulture (unpaid) at the Headquarters of the Ministry.

Mr. Lobjoit is President-Elect of the Chamber of Horticulture, Chairman of the Agricultural Committee, the Small Holdings Committee, and the Agricultural Education Committee of the Middlesex County Council, of which he is also an Alderman ; Chairman of the Market Gardening, Fruit-growing and Hop Committee of the Central Chamber of Agriculture ; Examiner to the Royal Horticultural Society ; and Member of the Horticultural Advisory Committee of the Ministry of Agriculture. Mr. Lobjoit is also a well-known writer on horticultural subjects, and has a lifelong practical experience of market gardening on a large scale.

Fruit Crop Prospects on 1st July.—It was stated in a notice issued by the Ministry on 3rd July that, so far as can be seen, the prospects relating to bush fruit appear to be generally good. Certainly gooseberries have yielded remarkably well, and raspberries are carrying heavy crops. The strawberry crop, owing to early drought, is much lighter than was anticipated at the beginning and will yield only fairly. The black currant crop is very much on the light side. The top fruit crops are very uneven throughout the country. While one orchard appears to be giving fair crops the next one is almost a total failure. Of plums, Monarch appears to have done well, giving in some cases heavy yields ; Pershore are but a fair crop, and in Evesham growers expect to get about ½ crop ; cherries are decidedly thin and it is doubtful if many growers will clear expenses. Apples generally are scarce, though some of the early cooking varieties are bearing a medium crop this season, and even isolated patches of Worcesters are to be found. In the Norfolk fruit area, which is but a small though an increasing fruit district, the apple crop is good. Nuts, of which the Kentish Cob is probably the most famous, have not been abundantly produced this year, and something less than half a crop is anticipated.

The statistics received by the Ministry relating to plums appear to show that Victorias are producing only about 10 per cent., Pershore 80 per cent., Tzars 15 per cent., Damsons 33 per cent. of the crop produced in 1919, while Monarch is giving about 15 per cent. more than in 1919.

Alteration in the Date of Publication of this Journal.—Commencing with the September issue, this *Journal* will be published on the 1st of the month, instead of on the 15th, as heretofore. The August issue will be issued about the 7th August.

ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous

- Rhode Island Agricultural Experiment Station.*—Bull. 180:—A Field Comparison of Hydrated Lime with Limestone of Different Degrees of Fineness. (18 pp.) Kingston, R.I., 1919. [63.15.]
- University College of North Wales, Department of Agriculture.*—Formation of Pastures. (11 pp.) Bangor, 1920. [63.33(a).]
- U.S. Department of Agriculture.*—Circ. 84:—Crop Injury by Borax in Fertilisers. (35 pp.) Washington, 1920. 10 cents. [63.168.]
- University College of N. Wales, Department of Agriculture.*—Reports on Experiments, 1917 to 1919. (51 pp.) Bangor, 1920. [63.06.]

Field Crops—

- Kentucky Agricultural Experiment Station.*—Bull. 221:—Marketing Hemp (19 pp.) Lexington, 1919. [63.34112.]
- California Agricultural Experiment Station.*—Bull. 309:—The Carob in California. Nutritive Value of the Carob Bean. (22 pp.) Berkeley, 1919. [63.32.]
- Bradbury, F.*—Flax Culture and Preparation. A Complete Description of the Process from Selection of Seed to Preparation for the Market. (154 pp.) London: Sir Isaac Pitman & Sons, 1920. 9s. net. [63.34111.]
- Amos, A.*—Ensilage. (42 pp.) [Jour. of Farmers' Club, 1920, Part 2.] 6d. [63.1985.]

Horticulture—

- Kentucky Agricultural Experiment Station.*—Bull. 216:—Strawberries (28 pp.) Lexington, 1918. [63.41(c).]
- Kentucky Agricultural Experiment Station.*—Bull. 218:—Some Experiments with Tomatoes. (11 pp.) Lexington, 1918. [63.513.]
- California Agricultural Experiment Station.*—Bull. 310:—Plum Pollination. (28 pp.) Berkeley, 1919. [63.41(08); 63.41(b).]
- Tennessee Agricultural Experiment Station.*—Bull. 121:—Pruning and Spraying the Home Orchard and Vineyard. (47 pp.) Knoxville, 1918. [63.41-195; 63.294.]

Plant Diseases—

- Canada, Department of Agriculture.*—Crop Protection Leaflet 12:—The Beet Webworm. (*Loxostege sticticalis*, L.) (3 pp.) Ottawa, n.d. [63.27.]
- Kentucky Agricultural Experiment Station.*—Bull. 213:—Observations and Experiments on the Bean and Pea Weevils in Kentucky. (27 pp.) Lexington, 1917. [63.27-32.]
- Illinois Agricultural Experiment Station.*—Bull. 217:—An Apple Canker due to *Cytospora*. (15 pp.) Urbana, 1919. [63.24.]
- Illinois Agricultural Experiment Station.*—Bull. 220:—Black Spot of Onion Sets. Caused by *Volutella circinans*. (26 pp.) Urbana, 1919. [63.24.]
- U.S. Department of Agriculture.*—Bull. 808:—Studies on the Life History and Habits of the Jointworm Flies of the Genus *Harmolita* (*Isosoma*), with Recommendations for Control. (27 pp.) Washington, 1920. 5 cents. [63.27; 63.27-31.]
- U.S. Department of Agriculture.*—Farmers' Bull. 1061:—Harlequin Cabbage Rug (*Murgantia histrionica*, Hahn) and its Control. (16 pp.) Washington, 1920. [63.27.]

Live Stock—

- Indermuhle, K.*—Rindviehzucht. Herausgegeben vom Verbands der Lehrer an landwirtschaftlichen Schulen der Schweiz. (85 pp.) Frauenfeld, Huber & Co., 1920. [63.62(02).]
- Heiderich, Dr. F. (Edit.).*—Die Viehzucht im österreich-ungarn. (248 p.p.) Wien, Handels, Museum, 1919. [63.6(436).]

- Faber, H.*—Forage Crops in Denmark. The Feeding Value of Roots, Selected Strains of Roots and Grasses, Guarantees in the Trade in Seeds. (100 pp.) London: Longmans Green, 1920. 6s. [63.33(02).]
Maine Agricultural Experiment Station.—Bull. 272 :—Inheritance Studies of Certain Colour and Horn Characteristics in First Generation Crosses of Dairy and Beef Breeds. (20 pp.) Orono, 1918. [575.1 ; 63.62(04).]

Dairying and Food, General—

- Ontario Department of Agriculture.*—Dairy Branch Circ. 20 :—Cool Sweet Milk Makes Most and Best Cheese. (4 pp.) Toronto, 1919. [63.717.]
Ontario Department of Agriculture.—Dairy Branch Circ. 21 :—Keep Cream Cold and Sweet. (4 pp.) Toronto, 1919. [63.717.]
Ontario Department of Agriculture.—Dairy Branch Circ. 22 :—Why Should the Milk of the Individual Cow be Weighed and Tested, and Records kept of the Results? (4 pp.) Toronto, 1919. [543.2.]
Ontario Department of Agriculture.—Dairy Branch Circ. 26 :—Ice on the Farm (2 pp.) Toronto, 1920. [664.8.]
Kentucky Agricultural Experiment Station.—Bull. 217 :—Profitable Dairy Farm Organization in Kentucky. (50 pp.) Lexington, 1918. [63.7(72) ; 63.714.]
U.S. Department of Agriculture.—Farmer's Bull. 1078 :—Harvesting and Storing Ice on the Farm. (31 pp.) Washington, 1920. [664.8.]

Veterinary Science—

- Kentucky Agricultural Experiment Station.*—Bull. 207 :—Studies in Forage Poisoning, V.: A Preliminary Report on an Anaerobic Bacillus of Etiologic Significance. (65 pp.) Lexington, 1917. [619(04).]
U.S. Department of Agriculture.—Circ. 82 :—A New Sheep-Poisoning Plant (*Daubentonia longifolia*) of the Southern States. (4 pp.) Washington, 1920. [63.255.]

Birds, Poultry and Bees—

- Kentucky Agricultural Experiment Station.*—Bull. 220 :—The Effect of Certain Grain Rations on the Growth of the White-Leghorn Chick, and their Influence on Subsequent Egg-production. (20 pp.) Lexington, 1919. [63.6515.]
U.S. Department of Agriculture.—Circ. 79 :—Tropical Fowl Mite in the United States, with Notes on Life History and Control. (8 pp.) Washington, 1920. 5 cents. [59.169.]
U.S. Department of Agriculture.—Circ. 76 :—Directions for Collecting Flowering Plants and Ferns. (8 pp.) Washington, 1920. 5 cents. [579.]
U.S. Department of Agriculture.—Bull. 804 :—A Study of the Behaviour of Bees in Colonies Affected by European Foul-Brood. (27 pp.) Washington, 1920. 5 cents. [63.81(04).]

Engineering—

- U.S. Department of Agriculture.*—Circ. 149 :—Proposed Farm Power Studies, as outlined by the Farm Power Conference and the Departmental Committee on Farm Power Projects. (8 pp.) Washington, 1920. [63.17(04).]

Economics—

- Australia Commonwealth.*—Census of the Commonwealth, taken for the Night between the 2nd and 3rd April, 1911. Vol. I. Statistician's Report including Appendices. (480 pp.) Melbourne, 1917. [312(9).]
Rogers, J. E. T.—Six Centuries of Work and Wages. The History of English Labour. (591 pp.) London: Swan, Sonnenschein & Co., 1891. 10s. 6d. [331.]
Weaver, Sir L.—Village Clubs and Halls. (112 pp.) London: Offices of "Country Life," 1920. 7s. 6d. net. [36.]
Select Committee on Land Values.—Report of the Committee, together with Proceedings, Minutes of Evidence and Appendices. (96 pp.) London: H.M. Stationery Office, [Cmd. 556], 1920. 1s. 6d. net. [336.22.]

SELECTED CONTENTS OF PERIODICALS.

Agriculture, General and Miscellaneous—

- Potassium-Bearing Minerals as a Source of Potassium for Plant Growth, *E. de Turk*. (Soil Science, October, 1919.) [63.1673.]
- Plant Ashes as a Source of Potash. (Bull. Imp. Inst., July–September, 1919.) [63.1673.]
- Notes on Agriculture in Cyprus and its Products, *W. Bevan*. (Bull. Imp. Inst., July–September, 1919.) [63(5).]
- Pflanzenanalyse und Düngerbedürfnis des Bodens, *Dr. Munier*. (Jour. f. Landwirtschaft. Band 67, Heft 4.) [63.161.]
- Die Bedeutung der Geologie für die land und forstwirtschaftliche Bodenkunde, *H. Niklas*. (Natur. Zeit. Land. und Forst, January–February, 1920.) [55.]
- Wie soll der Land- und Forstwirt geologische Karten lesen? *M. Schuster*. (Natur. Zeit. Land. und Forst, January–February, 1920.) [63.111.]
- The Use of Potash Salts, *J. Hughes*. (Jour. Bath & W. Agric. Soc., Vol. XIV., 1919–20.) [63.1673.]

Field Crops—

- Zur Frage des Anbaues und der Akklimatisation der Soja in Deutschland. (Natur. Zeit. Land. und Forst., January–February, 1920.) [63.321.]
- Sugar Beet Culture, *S. L. Bastin*. (Jour. Bath and W. Agric. Soc., Vol. XIV., 1919–20.) [63.3432.]

Live Stock—

- Government Govt Farm [U.S.A.]. (Breeder's Gazette, 4th December, 1919.) [33.638.]
- Fütterungsversuch mit aufgeschlossenem Stroh (Kochstroh, Kraftstroh). (Milch Zentralblatt, 15th February, 1920.) [63.604(a).]
- The Ideal Estate Pig—The Gloucester Old Spot, *A. Nicholson*. (Jour. Land Agents' Soc., April, 1920.) [63.64.]
- Scottish Pure Bred Live Stock (iii.) Galloway Cattle, *F. N. M. Gourlay*. (Scot. Jour. Agric., April, 1920.) [63.62.]
- The Improvement of Live Stock in Relation to the Size of the Farm. *J. Long*. (Jour. Bath & W. Agric. Soc., Vol. XIV., 1919–20.) [63.6(42).]

Dairying and Food, General—

- Some Effects of the War on the Dairying Industry, *Primrose McConnell*. (Jour. Br. D. Farmers' Assoc., 1920.) [63.7(42).]
- Dairy Farming in Switzerland, *J. Long*. (Jour. Br. D. Farmers' Assoc., 1920.) [63.7(494).]

Birds, Poultry and Bees—

- Pixell-Goodrich, H. L. M.*—Determination of Age in Honey Bees. (16 pp.) [Quar. Jour. of Microscopical Science, Vol. 64, Part 2, January, 1920.] [63.81(04).]
- The Importance of the Poultry Industry to Ireland, *L. Murphy*. (Jour. Dept. Agric. and Tech. Instr. for Ireland, Vol. XX., No. 2.) [63.65(415)].

Forestry—

- Forest Policy, *R. L. Robinson*. (Quar. Jour. of Forestry, April, 1920.) [63.49(04).]

Economics—

- Ausführungsbestimmungen zum Reichslebensmittelgesetz vom 11 August, 1919. (Zeit. des deut. Landwirtschaftsrats, Dezember, 1919.) [333.38(43).]
- The Village Clubs Association. (Jour. Land Agents' Soc., April, 1920.) [36.]
- Notes on Agricultural Costings, *J. Allison*. (Jour. Bath and W. Soc., Vol. XIV., 1919–20.) [338.58; 657.]
- Profit-Sharing in Agriculture, *Lord R. Cecil*. (Jour. Br. D. Farmers' Assoc., 1920.) [331.]

THE JOURNAL

OF THE

MINISTRY OF AGRICULTURE

Vol. XXVII. No. 5.

AUGUST, 1920

NOTES FOR THE MONTH.

THE shortage of cereals throughout the world makes it of great importance that during the next few years this country should produce the maximum yield of wheat of which the land is capable. In order to encourage the sowing of wheat the Government has promised that so long as the import of wheat is still controlled, the farmer will receive for his home-grown wheat, of sound milling quality, harvested in 1921, an amount equal to the average (c.i.f.) price of imported wheat of similar or comparable quality, and at the same time he will have the guarantee based upon the costs of production provided by the Agriculture Bill, which should secure him against serious loss. With this incentive on the part of the Government it is earnestly hoped that farmers will make every effort to relieve the present food situation by placing the largest possible area of their land under wheat. Farmers will be well advised, also, to use only the best varieties of wheat, of satisfactory germinating power. Under rich conditions preference should be given to a stiff-strawed variety producing grain of good milling quality. Of these, there are several on the market. In choosing a variety local experience is generally a safe guide to follow; in cases of doubt, application should be made to the nearest agricultural education centre.

Apart altogether from the question of breaking up more grass land, which may still, in suitable circumstances, be a perfectly sound policy, both nationally and economically, there are many ways of adding considerably to next year's wheat acreage. In this connection this year's bare fallows are calculated to play a very important part. The intensive corn production of the war years has, in many cases, left a legacy of weeds and impaired

productivity, and consequently farmers have had to deal this year with a greater extent than usual of bare fallows. Fortunately, the weather has been very favourable for bare-fallowing. Weeds will have been turned to useful account in the form of humus, and the soil will have recovered in fertility and in the condition known to farmers as "tilth." The importance of a good tilth cannot be overrated; no amount of subsequent manurial or mechanical treatment will make up for the deficiencies of a bad seed-bed. Farmers, therefore, especially on heavy land, should resist the temptation to sow a catch crop on a fallow already clean, and should reserve the land for the early sowing of autumn wheat. The sheeping off or ploughing in of a green crop may, in the case of a heavy soil in a wet autumn, result in the loss of soil texture and of the advantages of an early seed-bed.

Early sowing is likewise possible in many cases after "seeds" hay. The past year was not, generally, favourable for "seeds," particularly clovers, and the result has been in not a few cases a thin plant, with weeds taking the place of the absent clovers. In such cases it would, as a rule, be advisable to forego the aftermath and break up immediately the hay crop is off the ground. A half-fallow in favourable weather will, if kept rough as long as possible, kill the weeds and mitigate, if not altogether prevent, attacks by wireworm. So, also, after picking peas, winter barley or winter oats, it will in many cases, provided that the weather is suitable, be possible to sow wheat early. Recent developments in machinery have provided farmers with an effective means of speeding up autumn cultivation, and the best way of recovering the capital outlay involved is to keep the machinery going while the days are still long and the weather favourable.

On typical wheat lands, more particularly those of a heavy nature containing chalk, corn crops may be successfully repeated several times. The main consideration in this connection is suitable manuring, and either dung or artificial manures may be used with an equal measure of success.

Wheat will doubtless be sown to an appreciable extent in circumstances other than those mentioned; it is mainly desired here to draw attention to the importance of early sowing. If the seed is sown early the plant is able to make good growth before the cold, wet weather sets in, and is thus in a better position to utilise plant food and prevent "washing" in the course of the winter. If it is too forward or too luxuriant in spring it can be sheeped off without damage, and will stand up all the better at harvest.

On the average, early-sown crops give the best return. Many farmers purposely delay sowing because they fear the development of "black grass." In our climate it is safe on the whole to utilise an early seed-bed and risk the black grass; a luxuriant crop has a smothering effect on weeds, while early sowing will save seed and manure. As regards the latter, however, it may safely be said that wheat will repay the judicious use of artificial manures as well as, if not better than, most crops. The main requirement is nitrogen. About $\frac{1}{2}$ cwt. per acre of sulphate of ammonia should be applied at seed-time, followed by another $\frac{1}{2}$ to $\frac{3}{4}$ cwt. in early spring, if the condition of the crop warrants the additional dressing. In the case of wheat after a straw crop, about 2 cwt. per acre of superphosphate or 4 to 5 cwt. of basic slag should also be harrowed in at seed-time. Farmers are advised to obtain their supplies of manures early.

* * * * *

OF all the unpromising propositions that could be taken in hand for garden purposes, a gravel pit at first sight might very well appear the least attractive. Nevertheless Mr. G. J. Bolingbroke, of Springfield, near Chelmsford, has shown how, by taking advantage of opportunities and exercising great ingenuity, obstacles can be overcome and an apparently sterile waste be made to produce an abundance of the choicest fruit. By the courtesy of Mr. Bolingbroke, the Ministry is able to publish the following account of his undertaking.

Some fifteen years ago the excavation of gravel which had been commenced by Mr. Bolingbroke 25 years ago in a quarry near his home ceased, and a hole over 60 feet deep and extending to about $\frac{3}{4}$ acre remained. The local authorities were in need of just such a place to deposit town refuse, and permission was given for them to lease the pit for this purpose. Later on, large building operations were commenced in the neighbourhood, and Mr. Bolingbroke again offered the use of the pit for the disposal of the excavated earth, and many hundreds of yards of the very best top soil, together with the top soil and waste earth arising from the working, was thrown in on top of the rubbish. In the course of about five years the lowest level of the pit had been raised to some 50 feet from the surface, and the hitherto almost perpendicular sides had been converted into slopes which seemed to Mr. Bolingbroke to present an ideal situation for fruit trees and garden crops. These were tried tentatively at first, but the results were such as to justify his highest hopes, and

operations were thereupon commenced which continued over most of the intervening years and have resulted in the plantation of some 550 trees. These consisted of cordon, wall, bush, pyramid and standard trees.

Shelter at the top of the pit in the form of a long brick wall and hedges already existed. The slopes were laid out in terraces upon which, as well as around the top, broad walks exceeding half a mile in length in all, with borders on either side, were constructed. The intervening slopes were covered with a thin layer of cement and sand, upon which choice fruit trees have been trained, and the walks connected with each other and with the bottom by concrete steps. The accompanying illustrations show the arrangements very clearly, but it was taken some years ago, and the slopes have since become fully covered. Some trouble was at first experienced from subsidence, but the effects of this are very little seen now. In consequence of the depth of the pit and the slope of the sides, neither sun nor rain is wasted, and an ideal forcing atmosphere is produced, so much so that crops are two or three weeks earlier than on the level ground above, late frosts are almost unknown, and ideal, summer-like conditions of climate are produced even in mid-winter.

The long brick wall previously mentioned is on the western side of the pit, and consequently has an eastern exposure. It is clothed with well-trained Morello cherries, and a visit at the middle of May showed them well set with fruit. Some two yards from the edge of the pit a long row of cordon Cox's Orange Pippins surround the west and north, and at this time gave promise of a fair crop. Between these and the edge is the path, and on the extreme edge is a trellis carrying the upper branches of the Doyenne du Comice pears trained against the slope below. These pears carried a very heavy crop of specimen fruit last year, and it is curious to note that, although there is not a heavy set below, the branches on the trellis have set fruit very thickly, without artificial fertilisation of any sort.

On the upper walk the slopes were almost entirely covered with well-trained pears: Doyenne du Comice facing east and south-east; 5 Louise Bonne of Jersey, which had again set well, although they matured over 2,500 fruit last season, and a few Emile d'Hayst facing west; 4 peaches facing south-west; and Morello cherries facing north. Round the edge of this walk are cordons of Cox's Orange Pippin apples and Louise Bonne of Jersey pears, mostly well set. A good bed of lettuce occupied a corner facing south-east, cabbage were finished, and cos lettuce just coming on.



FIG 1.—Quarry Fruit Garden, Lancaster House, Springfield, Chelmsford.



FIG. 2.—Another Section of the Fruit Garden



FIG. 3.—Another Section.

On the lower walk trained trees of Pitmaston, which last year produced record fruit, including two specimens weighing 24 and 28 oz., faced west, and a few more peaches south-west. Monarch and other plums showing an abundance of fruit, but like so many others this year rather troubled with green fly, faced south-east, and a small plantation of bush Morellos faced north-east, with trained trees of the same on the north wall. Around the edge of this walk were bush and half standard Cox's Orange Pippin and Worcester Pearmain, all setting well, interspersed with early potatoes, and in the south-east corner a small plantation of Whinham's Industry gooseberries. About 15 years ago two old Waterloo peach trees were planted here as standards, and bore regular crops (including over 1,500 fruits in 1914) until quite recently, when, being nearly 80 years old and worn out, they were destroyed.

On the lowest slope were trained Cox's Cordon Orange Pippin, mostly well set, and on the level ground, now 50 feet below the surface, were about 40 healthy and well-grown specimens of bush peaches, pears and apples. In between these trees and on all the slopes daffodils, narcissus and other bulbs were planted in quantity.

Watering the fruit trees has been found quite unnecessary, and it is thought that the slopes collect the rain and carry it to the roots of the trees. Manure is generally applied in the form of a mulch in summer, and a proprietary plant food has occasionally been used. The trees have been kept clean and healthy by occasional winter washing with caustic soda, and, when necessary, biting and sucking insects have been disposed of by means of arsenate of lead and quassia-soap sprays respectively.

On the ground adjoining the pit an excellent fruit store to hold upwards of 800 bushels of fruit has been built in two storeys, the lower of which is underground and keeps fruit in good condition to a very late period—this year until the end of May.

The whole undertaking provides an invaluable object lesson on the utilisation of waste land.

THE Ministry, with the approval of H.M. Treasury, has appointed Dame Meriel Talbot, D.B.E., to be Woman Adviser to the Ministry. The object of this appointment is that the fullest use may be made of women's experience, interest and work in the agricultural and rural life of the country. Dame Meriel

**A Woman Adviser
to the Ministry.**

Talbot, who has previously served as Director of the Women's Branch of the Food Production Department, has held several important public appointments, and has been connected with the Ministry for several years.

The Woman Adviser will be specially responsible for the recommendation of suitable women to serve on the Councils of Agriculture for England and Wales, the Agricultural Advisory Committee and the County Agricultural Committees and their Sub-Committees. She will make it her business to keep in touch with these bodies in order to see that women's opinions and interests are not overlooked. She will also watch the work of the Women's Institutes throughout the country and advise the Ministry with reference to grants to the Federation of Women's Institutes and kindred bodies. She will keep in close touch with the Director of Rural Industries, and will co-operate with him in any measures that can be taken to enlist the help of women in all schemes framed for the welfare or betterment of village life.

The Minister attaches great importance to arousing and retaining the interest of women in all agricultural and rural matters, and Dame Meriel Talbot will attend those conferences and committees at which matters affecting women are discussed or where a fuller knowledge of the Ministry's policy may be acquired. The welfare of the women of the country is closely bound up with the progress of agriculture. It follows that the appointment of a woman specially trained in public affairs and particularly in the work of many organisations that exist for the benefit of rural districts and rural industries cannot but prove a valuable factor in the present movement for stimulating women's interest in all matters relating to the land.

THE conditions arising in regard to horticulture during the War, and the work of the Food Production Department during that period, indicated the urgent need for the future development of national education in the production of fruit and vegetables. Hitherto large quantities of fruit and vegetables have been imported in the past, but might have been grown to advantage in this country, and from several standpoints it is important that we should produce more food, so as to become as

nearly self-supporting as possible. Lack of knowledge of the proper methods of culture has been largely responsible for our neglect of horticulture in the past, and the first step was the adoption of an extended scheme of instruction. The problem has been engaging the attention of the Ministry for some considerable time.

The importance of increased home production of all foodstuffs was apparent, and the Government set aside a considerable sum of money for the purpose of agricultural education and research, including horticultural education. It was considered that the best interests of the country would be served by an extension of the system of decentralisation. Some details as to this development will be of interest to all concerned in horticulture.

The first step was naturally the investigation and consideration of all past schemes of education to discover what errors had been made and what class of work had achieved the most useful results. It was shown that propaganda by lecture and leaflet only did not produce results fully commensurate with the money and energy expended. The Ministry therefore decided on a new scheme, the key-note of which is *the practical demonstration of approved economic methods of production of fruit, vegetables, and of honey, combined with manual, graphic and oral teaching, with the object of increasing production, efficiency in production, and the elimination of unprofitable varieties*

The administrative work is placed in the hands of the Local Authority, who has power to set up Horticultural Sub-Committees. For the assistance of these Committees in revising existing, and in formulating new schemes, the Ministry has prepared and distributed to all those officially concerned a comprehensive memorandum embodying a complete although elastic scheme, which can be adapted to suit the particular needs of each county. This aims at the establishment of a Horticultural Instruction Centre at the Farm Institute, where demonstration fruit and market garden plots and apiaries will be established. These form the practical basis for the courses of teaching which will be varied to suit the needs of all districts. For those who intend to follow fruit and vegetable production as a business, a full year's course of day classes at the centre will be provided. This course, although not sufficiently equipping a student to commence business immediately, will form a sound basis of technical education.

For those who are unable to attend day courses, evening courses would be held either at the instruction centre or at convenient places in the county, and to assist established market gardeners and fruit growers meetings would be arranged at which approved methods would be discussed. The grounds at the centre would be available for such practical tests and experiments as the needs of the county indicate.

The allotment movement, which is now so firmly established and embraces over 1,000,000 holders, is of national importance and has not been overlooked. This would be provided for by the establishment of demonstration plots in all suitable areas.

A SCHEME for combining market gardening with poultry keeping has been proposed by the Ministry, with a view to ascertaining how far it is possible to carry on a system of market garden cropping on a small area and at the same time to keep upon it a certain number of fowls. Three areas of one acre each have been selected, viz., at Titchfield, in Hampshire, Methwold, in Norfolk, and Rolleston, in Nottinghamshire. The acre is in each case to be divided into four quarters, and the cropping on each quarter is to be arranged so that the birds, 150 in number, are three months of the year on each quarter. A central fowl house is to be constructed, fitted with sliding doors to enable the birds to be transferred from one quarter to another according to the state of the cropping and the period during which the birds are intended to occupy any particular quarter. The manure produced each three months in any one section will be equally distributed over that section. The cropping is arranged so as to admit of the land being properly worked in the interval following the removal of the birds. Catch crops, mustard and rye for green manure, will be also introduced where possible in rotation. It is hoped that by these experiments some information will also be gained as to (1) the value of poultry manure for crops on ground in a low state of fertility, and (2) the rate at which poor land may be brought into a fertile condition by poultry manure alone.

It is understood that certain Councils have been considering the desirability of providing fruit trees for some of their small holdings, and in view of the present shortage and the difficulty of obtaining trees of good quality and true to name, the Ministry has made arrangements for the supply of a limited number of fruit trees for planting during the coming autumn and in the autumn of 1921. The trees are not to be sold by the Council to their tenants, but are to remain the property of the Council, who will arrange for their proper planting and recoup their outlay by means of a suitable increase in the rent of the holding.

The arrangements made provide for the supply of the following varieties:—

Apples.

Bramley's Seedling
Newton Wonder
Lane's Prince Albert
Grenadier
Early Victoria
Beauty of Bath

Gladstone
Worcester Pearmain
Allington Pippin
James Grieve
Rival

Plums.

Victoria
Czar
Purple Egg Plum
Early Rivers
Belle de Louvain

Pears on Quince.

Conference
Dr. Jules Guyot
Fertility

A proportion of the apples will be supplied on Paradise and others on Crab stocks. All the two-year-old trees to be supplied in 1921 will be "feathered." It is advisable that a high standard of selection shall be maintained on holdings where fruit is planted, and in order that this standard may be attained the Ministry has arranged for the fruit trees to be carefully examined with a view to ensuring their freedom from disease.

The price to be charged for the maiden trees supplied this autumn will be £10 10s. 0d. per hundred, free on rail, packing extra. It is not possible at present to quote a definite price for the two-year-old trees to be supplied next year.

BEFORE the War the production of fish meal had become a considerable industry at the larger fishing ports of the United Kingdom. In 1913, out of 40,000 tons produced, 30,000 were exported to the Continent, mainly to Germany, where fish meal found a ready sale. In this country it has been used in steadily increasing quantities to feed pigs and poultry, but has been little employed for the food of other classes of live stock. **Fish Meal as Food for Live Stock.** Manufacturers will be obliged to resume the export trade unless British farmers will recognise the value of this product as a feeding stuff. Purchasers should distinguish between fish meal manufactured for use as a feeding stuff and the manurial article sold under the title of fish guano. The fish meal for feeding is made from fresh offal, together with whole fish that are unsaleable owing to a glut in the market. Care is taken that the ingredients be wholesome, but in the preparation of fish guano the question of suitability for animal feeding does not arise, and this product should therefore be avoided as a foodstuff. The composition of fish meal varies, but it should contain over 50 per cent. of proteins (albuminoids) and 25 per cent. or so of ash, which mainly consists of phosphate of lime. It is, therefore, specially rich in proteins and phosphate of lime, flesh and bone formers. Owing to the small proportion of carbohydrates, fish meal cannot exercise its full value unless it is used together with other feeding stuffs rich in this constituent, as for example, green fodders, roots and grain foods, or the more starchy feeding stuffs like maize and milling offals.

It has been objected that fish meal taints the carcass, but this occurs only where it has been given in undue proportion. A rough but useful general rule is that fish meal should not form more than about one-eighth of the total dry food consumed. This will produce pork and bacon of excellent quality, quite free from fishy taint, provided that the fish meal is good and not too rich in the fish oil which carries the fishy taint. For this reason careful manufacturers reject herrings as a constituent of fish meal.

In order to secure the essentials just noted, the Association of Fish Meal, Fish Guano and Fish Oil Manufacturers—representing nearly all the manufacturers of fish meal in Great Britain—has agreed to produce, from white fish only, a meal to be sold as “white fish meal,” and to conform with the following limits as to composition :—

Albuminoids	-	-	-	-	Not less than 55 per cent.
Phosphate of Lime	-	-	-	-	" " " 16 " "
Oil	-	-	-	-	" " " 5 " "
Salt	-	-	-	-	" " " 4 " "

Such a meal should be light brownish in colour, well ground, and free from large pieces of bone. It should be free, also, from the offensive smell of decayed fish. If its moisture content is not above 18 per cent., or thereabouts, the meal should keep well for a considerable period in a dry store, fitted preferably with a wooden floor.

In Scandinavia and elsewhere on the Continent, fish meal has been found very useful for all kinds of stock. The use in this country for pigs and poultry is large and still increasing. Recent experiments at Reading College proved its value as a supplementary food in rearing calves on whey. In this experiment, however, it should be noted that fish meal formed from cod liver was invariably rejected by the animals. Other fish meals, however, gave most satisfactory results. Scottish cattle feeders have found that it succeeds well to the extent of 2 to 3 lb. per head per day. Scandinavian farmers have demonstrated that 4 lb. or even more per head can be fed to dairy cows without imparting a fishy taint to the milk. Here, albuminoids are specially required, and it would appear, therefore, that fish meal has an especial usefulness in milk production. There is, however, a risk of direct contamination of the milk through the agency of the milker if he, or she, has happened to handle the foods before milking. Only where the greatest care is exercised can the use of fish meal for milch cows be recommended but where due precautions are observed, and the proportion of the richer cakes, such as decorticated cotton and earthen cake, is small, fish meal up to 3 lb. per head per day may be given without ill effects. In the rearing of calves fish meal is satisfactory because of its richness in albuminoids and bone phosphate. Experiments at Kilmarnock demonstrated the usefulness of the following mixtures:—

- | | | | | | |
|-------------|---|----------|-----------------|---|---------|
| (1) Oatmeal | - | 2 parts. | (2) Fine Thirds | - | 2 parts |
| Fish Meal | - | 1 part. | Fish Meal | - | 1 part |

These ingredients were mixed with boiling water into a kind of porridge and fed with whey. The whey and meals were introduced gradually when the calves were three weeks old, until at six weeks the supply of whole milk was entirely stopped, 1 gallon of whey and $\frac{1}{2}$ lb. of meals constituting the daily ration. This was increased gradually to $1\frac{1}{2}$ gallons of whey and 1 lb. of meals. Hay was introduced when the calves were five weeks old, and linseed cake three weeks later, fed in increasing quantity.

In the Reading experiments, carried out under the auspices of the Ministry, the following mixtures gave excellent results :—

- | | | | |
|--------------------|--------------|------------------|------------|
| (1) Linseed Meal | - 3 parts. | (2) Linseed Meal | - 2 parts. |
| Bean Meal | - 3 „ | Fish Meal | - 1 part. |
| Fish Meal | - 1 part. | | |
| (3) Linseed Meal | - - 3 parts. | | |
| Finely Ground Oats | - 3 „ | | |
| Fish Meal | - - 1 part. | | |

Beginning when the calves were two weeks old, the meals were fed with whey, gradually replacing whole milk until, at the age of one month, the calves received daily 1 gallon of whey and 1 lb. of meal. At the outset the meal was mixed with whey, but the calves soon took to it in the dry form. From four weeks onward they were given hay, and a little later a small allowance of linseed cake, coconut cake and maize gluten feed.

It is essential that fish meal used for calf-rearing should be of the best quality and finely ground. It is a useful supplementary food for sheep on roots and may be fed at the rate of 2 to 3 oz. daily per 100 lb. live weight, together with roots or other green food. For pigs, a useful proportion is from one-ninth to one-seventh of the total dry foods, rising in the last month to more than 1 lb. per head daily. Such feeding leaves no detrimental trace upon the colour, smell, taste or cooking qualities of the meat. Before feeding to pigs the sample should be tasted in order to see that it does not contain too much salt, which, in any appreciable quantity, is injurious.

* * * * *

DURING the season 1921 the Ministry has decided to permit the planting, in districts scheduled as Infected Areas under the

Wart Disease of Potatoes Orders, of first early potatoes of varieties susceptible to Wart Disease. The concession made to market growers in 1919 for the year 1920 to introduce fresh "seed" of first early susceptible varieties into Infected Areas will now be extended to all growers. The effect of this decision is that, next year, any true first early variety of potato, whether "own-saved" or otherwise, as well as the variety "Eclipse" and any variety recognised by the Ministry as being of the "Eclipse" type, may be planted in any land in an Infected Area other than land on which Wart Disease has been known to exist.

* * * * *

It is now generally felt that the requirements of agriculture for artificial fertilisers are likely to be much larger in the future

**Nitrogen from
the Air.**

than in former years. This may be anticipated especially with regard to nitrogen, of which increasing supplies will be needed in the development of a more intensive cultivation of the wheat-growing areas of the world. The imperative need for maintaining and extending the world's production of food, and the vital importance of combined nitrogen for this purpose, has been emphasised by the lessons of the War. Attention was drawn to the importance of increasing the nitrogen supplies of this country by the Nitrogen Products Committee, which was appointed by the Government in 1916 to consider the whole question of the development of this source of wealth. The Report of the Committee,* issued some months ago, contains a number of recommendations by which it is considered the output of nitrogen available for explosive and agricultural purposes might be increased. Details are also given in the Report of the various methods of the fixation of atmospheric nitrogen, in order that supplies may be utilised to the fullest possible extent. As is generally known, the methods have for their object the separation of the gaseous nitrogen from the air by a chemical process, and its conversion into a solid substance in a form readily available for use as a fertiliser or other purpose.

Definite measures seem now to be in progress for the fixation of atmospheric nitrogen on a scale commensurate with its importance to the security and economic stability of this country. A syndicate has been formed by Messrs. Brunner Mond & Co., and has acquired a factory and commenced the preliminary arrangements for the production of nitrogen by one of the several known processes of fixation. A short account of the objects of the syndicate and the work which has so far been accomplished was published in the issue of the *Journal of the Society of Chemical Industry* for 30th April last. It appears that the syndicate has selected the process which consists essentially in the manufacture of ammonia by the combination of nitrogen and hydrogen at a high temperature under pressure. The ammonia thus formed will be converted into nitric acid and nitrates.

It is pointed out in the article that the normal output of ammonia in this country is quite insufficient to supply the enormous demands for explosives in modern warfare, while ammonia in the form of ammonium sulphate is by far the most

* See this *Journal*, February, 1920, p. 1112.

important fertiliser we produce. To the extent to which it is used for explosives it must be diverted from agriculture just at the time when it is imperative to increase the home-grown food supply to the utmost extent. This was the situation with regard to ammonia during the War.

The case for increasing the home supplies of nitrogen is thus clearly established and urgent. Agriculturists may watch with close interest the results which attend the pioneer attempts in industry to render this country independent of foreign markets for our supplies of this essential fertiliser. It is on the success of such efforts, only in degree less than on the more direct efforts of the farmer, that the prosperity and security of British agriculture must largely depend.

WHILE the farmer in a large way of business may find it economical to use young horses solely for ploughing, older horses

The Small Holder's Horse.

for both ploughing and hauling, and others, again, for drawing light vehicles at a quick pace on roads, the occupier of a small holding is obliged to carry out all such work with the aid of one, or perhaps two, horses. To ex-service men and others who may be so placed, the question of the best type of horse is therefore important. The small holder's horse should be a general utility animal—one which, although it may not be the ideal horse for any particular class of work, can yet draw a plough or a loaded cart on the land, and can also travel to market with a cart containing farm or garden produce. It must be strong and active, and of the right age to perform constant work of every description.

With regard to the question of breed, it is possible to find suitable animals among Clydesdales, Suffolks, Shires, or crosses of these breeds. Sometimes crosses between heavy and light horses are found suitable. Much depends on the situation of the holding. In many districts, mountain or moorland ponies are used largely for draught purposes, except the small Exmoor and Welsh ponies, which are suitable only for pony traps. In parts of Wales, on Dartmoor and in the New Forest, there are ponies of the mountain and moorland breeds that may be described as the ideal draught animals for the small holder—inexpensive to keep, courageous, intelligent, resourceful and able to draw a considerable load at a reasonable pace. A note on these ponies appeared on p. 308 of last month's issue of this *Journal*.

Small holders in the neighbourhood of mountain and moorland districts will also find Borderland ponies very valuable. The Dale pony, for example, is used in the Dale and Fell districts of Westmorland, Cumberland and Yorkshire: The Devonshire cob is used in the Exmoor and Dartmoor districts. The larger truck pony of the New Forest is considered by many to be an ideal transport animal. Mountain and moorland ponies, however, are suitable for all parts of the country, with the reservation above-mentioned as regards Exmoor and Welsh ponies.

The beginner, when purchasing, should secure the assistance of someone who has had considerable experience of buying and selling. While it would be economical for a farmer on a large farm to select a young animal that is perfectly sound and free from blemish—an animal which should increase in value each year until it is five or six years old—the small holder's utility horse should be six years old or more when bought, and it should be purchased with a view to keeping it on the holding as long as it is able to do the work. When selecting a horse, a small holder need not necessarily reject an animal because of a blemish, provided that such blemish does not interfere with the horse's ability to work. Care, however, is needed to ensure that the animal is free from the grosser defects which unscrupulous dealers might wish to conceal.

In the Southern and Midland counties the horse should be turned out at night in a grass field all the year round, except possibly in very severe weather. If there be no paddock on the holding, the animal should be kept in a yard that has an open shed; on no account should it be tied up at night in a hot and stuffy stable. If the horse has been stabled, the transition to open-air life must be gradual.

A booklet on "The Small Holder's Horse" is published by the Ministry in the series of "Small Holders' Guides" (No. 4). Copies may be obtained on application to the Offices of the Ministry, 3, St. James's Square, London, S.W.1, price 2d.. post free.

* * * * *

AN important prosecution under the Horse Breeding Act, 1918, was heard recently in the Ripon City Court, when three farmers were summoned, on the information of the Live Stock Officer of the Ministry, for travelling a shire horse for service without licence. There was a second charge of exhibiting the horse, on premises not in the

Prosecution for Travelling an Unlicensed Stallion.

defendants' own occupation. Under the Horse Breeding Act, as was explained in last month's issue (p. 318), any person who at any time after the 1st January, 1920, being the owner or having the control of a stallion, which for the purposes of the Regulations under the Act is deemed to have attained the age of two years, travels the stallion for service, or exhibits it on any premises not in his occupation with a view to its use for service or permits it to be so travelled or exhibited, shall be liable on summary conviction to a fine not exceeding £20, unless the stallion is at the time licensed under the Act.

Evidence was given to show that the owners of the horse applied for a licence, and that the horse was examined on behalf of the Ministry. The Ministry informed the owners that the licence was refused, the examining Veterinary Surgeon having certified the stallion to be affected with a disease prescribed in the Horse Breeding Regulations (1919) as a disease rendering a stallion unsuitable for service of mares. The owners thereupon exercised their right of appeal, and the horse was further examined by a referee appointed by the Ministry. The report of the examining Veterinary Surgeon was confirmed, and the owners were notified that the appeal had failed, and that, in consequence, they must not travel the horse. The notice was nevertheless disregarded, and the Ministry, therefore, instituted a prosecution. The three owners were found guilty, and a penalty of £1 on each count was imposed, making £6 in all, and 3 guineas was allowed towards the solicitor's expenses.

The result of proceedings by the Ministry in two other cases has also been reported. At Stockton Police Court, on the 23rd June, a horsebreeder was fined £5 and £3 8s. 6d. costs for travelling two unlicensed stallions, and for failing to produce the licence for a stallion when asked to do so. In the other case, at Scorton (Yorks., N.R.) Police Court, on the 6th July, a stallion owner was fined £15 inclusive of costs for allowing his horse to travel for the service of mares, although a licence had previously been refused by the Ministry.

* * * * *

(1) *East Sussex (Romney Marsh).*—Since the issue of this *Journal* for June last, two further outbreaks of Foot-and-Mouth disease have been confirmed in what was known as the East Sussex Scheduled Area, viz., on the 4th and 5th June respectively. on holdings in close proximity to the original premises at

**Foot-and-Mouth
Disease.**

Running Waters, New Romney, Kent, on which the first case was confirmed on the 1st June. No further outbreak has since occurred in that district, and it is hoped that the remaining restrictions, which at present only apply to a very small area immediately around the infected places, may shortly be withdrawn.

(2) *Norfolk*.—Following upon the outbreak at Bowthorpe, Norwich, on the 1st June, referred to in last month's issue of the *Journal*, an outbreak was confirmed on the 7th June at Emneth, near Wisbech, Norfolk, in the occupation of the same owner. This extension necessitated the prohibition of the movement of animals over a much enlarged area, including the whole of West Norfolk, as well as parts of the Isle of Ely and the Holland division of Lincolnshire. Thereafter two further outbreaks occurred in the Bowthorpe scheduled area, and twelve more in the Emneth area. The last of the latter series was confirmed on the 19th July. It has been possible for the Ministry to make considerable modifications of the areas originally scheduled, and it is now hoped that, in the absence of unforeseen complications, there may be further contractions of the areas which are at present subject to restrictions on movement of stock.

* * * * *

THE possibilities of using the aeroplane as a means of transport for horticultural produce have recently received consideration in France and in England.

The Transport of Food Produce by Aeroplane.

In a note published in the issue of the *Journal d'Agriculture Pratique* for 3rd June last, the economic advantages in the conveyance of the choicer varieties of market garden produce to markets by aeroplane service were mentioned, while the subject was also discussed at a recent meeting of the French Horticultural Society. A writer commenting on this method of transport in the issue of the *Fruit, Flower and Vegetable Trades' Journal* for 5th June last, points out that in addition to the great saving of time by aeroplane transport, the atmospheric conditions during the flight of the machine produce the refrigeration necessary to keep the fruit cool and in perfect condition during transit.

Actual tests of this method of transport have been made. In one test in March last, a well-known French horticulturist sent strawberries from Saint Laurent du-Var in the Maritime Alps to the Central Market in Paris by aeroplane; and consignments

of crates of strawberries have also been made, and reached Covent Garden Market by aeroplane from Paris within four hours. In both of these cases the fruit arrived in good condition at the market, and the high prices realised completely justified the experiment from the financial point of view. So far, the fruit carried has been strawberries, but it may be anticipated that other choice fruits will be carried by this agency in the near future.

* * * * *

THE photograph here reproduced has been forwarded to the Ministry by Mr. E. Roberts, County Rat Officer for Devonshire,

**Rat Catching in
Devonshire.**

and illustrates in a very striking manner the success which has attended the efforts of three of the County Rat Catchers in the course of one week's work in North Devon.

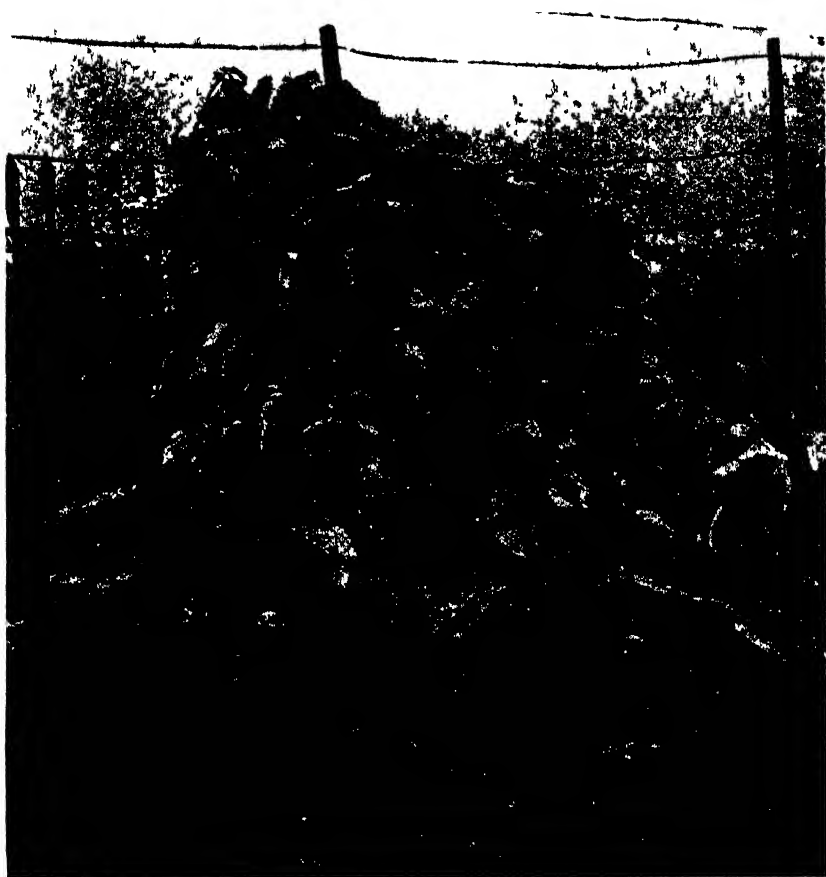
The saving of foodstuffs through such destruction will have been considerable. These 1,206 rats, if left undisturbed, would, by Boelter's computation of $\frac{1}{4}$ d. a day, have done in a year damage in foodstuffs alone at pre-war prices to the extent approximately of £460, or at present prices more than double that amount, leaving out of all calculation the increase in the number of rats that would inevitably have resulted from breeding. The rat, as is well known, is a very prolific breeder, so that when account is taken also of this fact, the potential saving would be many times the above figure.

This instance should bring home to all who may be responsible, either legally or under obligations of public duty, for undertaking measures for the destruction of rats, the value and importance of concentrated effort in the task. Public authorities, land owners, farmers, and others concerned, should realise that it is in their own as well as the national interest that measures should be vigorously prosecuted in all areas under their charge where rats are known to exist.

At a meeting of the Agricultural Wages Board held on Tuesday, the 6th July, the Board had under consideration observations from District Wages Committees

**Agricultural
Wages Board.**

with regard to a draft proposal to increase the minimum rates of wages for adult male workers throughout England and Wales by 4s. per week, and decided to give formal public notice of the proposal forthwith. Before an Order can be made bringing the proposed increases



Heap of 1,206 rats trapped by three of the Devon Rat Officers in a week
in North Devon

into operation a month must elapse from the date of the publication of the notice of proposal, during which period any objections to the increases may be lodged with the Wages Board for their consideration.

The Board adopted a report presented by Sir Henry Rew from the Committee on "Allowances" approving recommendations by the District Wages Committees for a number of counties for increases in the amounts at which employers may reckon the provision of board and lodging to workers as part payment of minimum rates of wages in lieu of payment in cash in the respective areas concerned.

It was decided to make Orders bringing into operation special rates of wages for hay and corn harvest work in Cumberland, Westmorland and Shropshire, and for corn harvest alone in Yorkshire.

The Board decided that no special rates should be fixed for the harvest in Hertfordshire, Middlesex, Dorset, Hampshire and Oxfordshire for the present year. It was also decided that the Order for Corn Harvest in operation for Oxfordshire last year should be cancelled.

The Board also made an Order, to come into operation on the 12th July, fixing revised minimum rates for female workers in Yorkshire: for workers aged 18 and over at 10d. per hour as proposed, together with proportionate rates for girls and for overtime employment.

An Order was made bringing into operation on the 12th July revised minimum rates of wages for male workers in Cheshire. The effect of the Order is that the minimum rates for male workers aged 21 years of age and over in Cheshire are increased in each case by 5s. 6d. per week, with proportionate increases for male workers under the age of 21 and in the overtime rates. The minimum rates for Cheshire will be further increased if the Board's general proposal (referred to above) for an all-round increase of 4s. per week in the minimum rates for adult male workers throughout England and Wales is in due course confirmed as an Order.

Full particulars of all Orders made by the Agricultural Wages Board are published in the *Wages Board Gazette*, the yearly subscription for which is 3s. Subscriptions should be sent to the Secretary, Agricultural Wages Board, 80, Pall Mall, London, S.W.1.

THE 1921 WHEAT CROP:

BRITAIN MUST GROW MORE.

SIR THOMAS MIDDLETON, K.B.E., C.B.

WITH the arrival of harvest the time has come for deciding on next year's wheat fields, and in this article reasons are given for urging every farmer who can grow wheat to sow as much as possible next autumn.

In most parts of the country the soil produces more food when growing wheat than when used for raising any other ordinary farm product except potatoes; and there is a limit to the demand for potatoes, while there is practically no limit to the demand for home-grown wheat.

Since a very small proportion (about 4 per cent.) of the 46 million cultivated acres of the United Kingdom grew wheat in the years before the War; since sales of wheat accounted for about 1s. 6d. in the pound only of the farmers' receipts; and since we imported four-fifths of our breadstuffs, there is a widespread impression, not only that the British wheat grower contributes a trifling amount to our total food supply, but that any effort which he might make to increase our wheat crop would have negligible results.

This impression is quite wrong, for in fact, with the exceptions of milk and potatoes, home-grown wheat contributes more to the food supply of the United Kingdom than any other farm product.

The Importance of Home-grown Wheat.—During the War a committee of experts prepared a careful estimate of the sources of the nation's food supply. It was then discovered that about 42 per cent. of our food was home-produced, and that the chief items in this percentage were: dairy produce 8·3, potatoes 7·4, wheaten bread 6, and beef 4. Meat of all kinds accounted for 10·5; but it must be pointed out that in the case of meat and also of milk the whole amount which came from our farms did not come from our own soils.

About 5 million tons of imported feeding stuffs were used in stock feeding, and if the amount of meat and milk made from these feeding stuffs is subtracted, the total percentage of the food supply derived through meat and milk from our soils would be reduced to 16.

The great importance of wheat to the nation may be stated in another way. Seventy-eight per cent. of our cultivated land

is required for the production of meat and milk; while this meat and milk between them provide about 42 per cent. of the total stock of food produced by our soils.

Wheat occupies 4 per cent. only of our cultivated land, while wheaten bread accounts for 16 per cent. of the stock of food grown on our soils. In addition, wheat offals and wheat straw contribute to the meat and milk supply; before the War less than 70 per cent. of the grain was made into bread.

If we are to make any substantial addition to our home food supply we must grow more wheat.

From these figures it may be shown that the land which we devote to wheat produces about seven times as much food per acre as the land we employ in stock-farming.

New Problems for the Producer.—For 50 years before the War the producer of British wheat regarded the consumer merely as a customer, and a bad customer he was! There was no obligation on the farmer to provide the public with bread, or, indeed, with any kind of farm produce except milk and potatoes.

But among those things which the War has changed most is the relationship between producers and consumers in this densely populated kingdom; for there are now indications that if we do not increase our home supplies we may have to go hungry. And if our people call for bread they will not be satisfied even should we offer them prime beef and mutton.

Much has been said recently in agricultural discussions about the danger of a serious fall in corn prices; there is at the moment quite as much risk of trouble for the farmer from a serious rise, for it will be agreed that scarcity prices for bread would not make agriculture a healthy industry.

The Minister of Food told the House of Commons recently that the average cost of North American wheat landed in this country in May was 148s. 8d. per 480 lb. Exchange, the wastage of war, coal, transport workers' wages, and many other factors affect price; but all of them together do not explain the present cost of American wheat. The great increase which has taken place in the last few months is due to a cause which has a peculiar significance for the British farmer.

In the five years ending 31st July, 1914, the principal wheat exporting countries shipped 18,000,000 metric tons of wheat.*

* A metric ton is 2,204½ lb.

Of this quantity 16,530,000 tons came from the following groups of countries:—

	<i>Tons.</i>
Canada, U.S.A., Argentina	7,800,000
Australia, India	2,800,000
Russia, Rumania	5,930,000

The total wheat crop of Canada, the United States, and Argentina in the five harvests 1909-13 averaged 28,200,000 tons. On the outbreak of war wheat growing rapidly extended, and, favoured by exceptional weather, the combined crops reached the gigantic total of 44,100,000 tons in 1915. 1916 was an unfavourable year, but the average production of the period 1915-19 was 33,520,000 tons, and last season's harvest yielded 36,700,000 tons.

Thus the American effort made up for the loss of the Russian crop. But what is the position in 1920? The United States, much the largest contributor to the total crop, has practically returned to its pre-war acreage, and although according to the June forecasts the crops are promising, the total yield expected is 22,000,000 tons, as against 25,600,000 tons last year and 18,700,000 tons in the period 1909-13.

Many other factors, such as the Argentine export duty, enter into this complicated question of wheat prices; but the present cost of American wheat appears to be chiefly due to the fact that the farmers of the United States, like the farmers of the United Kingdom, are rapidly reverting to pre-war farming; with consequences to their respective countries, be it noted, which may be very different.

Extensive Autumn Sowing essential.—The United Kingdom is the greatest purchaser of wheat (we took 5,880,000 tons per annum out of the total exports of 18,000,000 tons in the period ending July, 1914); the United States grows all the wheat she needs and a little more.

Americans went breadless to win the War, they have gone dry since the Armistice, but we cannot expect them to go hungry to oblige either the British consumer or the British producer. Our wheat supply is not their business. They will send us what they can spare, at a price. Other countries will do the same, and if seasons are propitious all will be well.

But do not let us forget that since 1914 wheat harvests have, on the whole, been good, that seasons have an unpleasant way of lapsing and that the wheat growing resources of the British Isles are undeveloped.

It is time, therefore, to cease arguing over the merits of guarantees, the dangers of low prices, the superb quality of our pastures, or the tearful propensities of our climate, and to get to work on the 1921 wheat crop.

The farmer has been delivered from the war conditions and war limitations of 1917; his labourers have returned, and he is free to select the land which, in his judgment, is best suited for wheat growing; he has had his "grouse" at the Food Production Department, its methods and its officials; now let him make his plans for autumn sowing; more than one of the chief offenders of 1917 will be well satisfied if in 1921 he beats the 1918 record.

THE PROGRESS OF AGRICULTURAL CO-OPERATION IN ENGLAND AND WALES SINCE THE ARMISTICE.

R. H. CARR,

Director-General, Agricultural Organisation Society.

ENGLISHMEN are by instinct and tradition a race of individualists, averse from combination except in the face of common dangers against which individual action is palpably of no avail, and proverbially given even then to "muddling through" rather than to systematic and well planned organisation. The communistic spirit, innate in certain other races, is singularly lacking in the English character, and there is perhaps no section of the community so markedly non-communistic as the agricultural. It is not therefore surprising that agricultural co-operation, autogenous in Denmark and some other countries, has been in this country a plant of slow and sporadic growth, and that its cultivation in the earlier stages of the movement involved the most unremitting energy on the part of the cultivators with results which were frequently disappointing and invariably patchy.

Furthermore, it follows that, the national genius being prone rather to action than analysis, the development of the co-operative movement in agriculture has received scant attention from the public and even from many of those who are most concerned with agricultural interests. Now that the movement has attained maturity—fully one-third of the farmers in England and Wales are at present members of co-operative societies—it is high time that a careful record should be compiled of its birth, boyhood and adolescence. Lecturers and students at agricultural colleges have not unreasonably complained that, whereas there is no lack of literature respecting the corresponding movements in other countries, there is no available record or text book concerning the movement in this country. It is not possible here to attempt more than a rapid and necessarily superficial survey of progress during the past few years. The Agricultural Organisation Society, however, contemplates the issue at an early date of a book which, it is hoped, will to some extent repair the omission which has been indicated.

Early Years of the Agricultural Organisation Society.—From its formation in 1901 down to 1917 the Society was

engaged in the work of starting agricultural co-operative societies in every village and district in which the local farmers could be induced to attempt combined trading on a co-operative basis. Its attitude towards these societies when formed was naturally somewhat paternal, and, as the Report of the Society for 1917-1918 candidly declared, the government of the Agricultural Organisation Society was bureaucratic, with a lack of intimate contact between the societies and the central governing body, which automatically increased as the movement itself developed. With the limited resources at its disposal the Society could not undertake a general propaganda throughout the country, nor was it in a position effectively to co-ordinate the organisation and development of societies, and its efforts were mainly confined to following up inquiries received from localities where some person was already interested in agricultural co-operation.

The Present Policy.—In 1917 the Governing Body under the Chairmanship of Mr. Leslie Scott, K.C., M.P., resolved to divest the Society of its paternal character and to democratise it fully so that it might become the servant rather than the patron of the affiliated societies. The character of the Governing Body itself was changed by the substitution of the elective principle for that of nomination. Fifteen branch committees were set up in the provinces, composed of representatives of the local societies, and charged with the supervision of local administration. The system of referring questions of policy and principle to conferences of societies was developed, with the result that to-day the affiliated societies through the length and breadth of the country are in a position not only to determine the composition of the Governing Body, but also to decide for themselves the big questions of policy which arise from time to time.

The democratisation of the movement was naturally and rightly followed by a drastic reorganisation of its machinery. The movement itself at that stage was obviously not in a position to provide the necessary funds to meet the expense of the organisation required, but fortunately the Government found themselves able to adopt the strong recommendations made in 1917 by the Agricultural Reconstruction Committee over which Lord Selborne presided, and to provide considerably increased grants from the Development Fund for the promotion of agricultural co-operation. The Society, therefore, when the Armistice was signed, found itself well equipped to meet the anticipated demands from the agricultural community for a big

extension in co-operative organisation, and these anticipations were more than realised during the following year.

Propaganda Campaign.—The first essential was to preach the principles and expound the methods of co-operation in every agricultural district throughout the country, and a special propaganda campaign was instituted in February, 1919, in the course of which public meetings were held at all the principal market towns in England and Wales, with supplementary village meetings in the evenings in the areas where market towns were scattered and difficult of access. The actual results of this campaign exceeded the most sanguine expectations, and at its conclusion in January, 1920, the Society was able to report that some 900 propaganda meetings had been held during the year, that these meetings had recruited on the average 100 farmers a day as members of the local societies, and that fresh capital had been raised for these societies to the extent of over £300,000. During the period of just under twelve months the membership of farmers' co-operative societies in England and Wales increased by over 40 per cent., and their share capital by well over 100 per cent.

Organisation of Affiliated Societies.—The results, from the point of view of co-ordination and systematic organisation, were even more important. A careful study of the distribution, types and operations of the affiliated farmers' societies in 1918, in conjunction with the map of England and Wales, revealed the fact that societies had been started in the country without reference to each other and on no preconceived plan which would admit of proper co-ordination. Every imaginable type, from the large general trading society covering two or three counties and dealing with every aspect of its members' business, down to the village society of a dozen members co-operatively owning a single threshing machine, was in existence, and little attempt had been made to bring these scattered units together and to work out schemes appropriate to each area which could be developed so as to provide for all the needs of the local agricultural community. Many important producing areas were unprovided with any form of co-operative organisation. Others were congested with small societies competing with each other for existence. What was obviously needed was an application of the principles inherent in modern town planning, combined with an intelligent appreciation of the individual characteristics

and needs of each area, whether geographical, physical, or determined by local predilections or prejudices.

This was the main problem which confronted the Governing Body in 1919 on the side of organisation as distinct from propaganda. In each area in turn it was found that the success of the propaganda campaign was in direct proportion to the thoroughness with which the scheme of organisation had been worked out in advance. In its report for the year 1919-1920, which is on the eve of publication, the Society has been able to announce that, with the exception of Middlesex, Huntingdon, Bedfordshire, Merionethshire, Radnor and Cornwall, in regard to which important developments are under weigh, every county in England and Wales is now adequately provided with large co-operative farmers' societies extending over a wide area. In a number of cases the local societies have amalgamated to form a single county society; in others it is found preferable to carry on two or more societies under a working arrangement which provides for the definition of areas and prevents overlapping. The framework is there; the intensive development of the societies is in active progress.

The Attitude of the big Farmers.—The policy of the Society in advocating the development of large general trading societies in contradistinction to the village societies, which are so marked a feature of agricultural co-operation in Denmark and Ireland, has met with criticism, particularly from the industrial co-operative movement, whose problems are essentially different in character, and has also led in some quarters to the wholly erroneous impression that the movement in this country has been oriented in the direction of the big farmers to the gradual exclusion of small farmers and small holders. It is true that, whereas in the earlier stages the movement was mainly confined to small farmers, as under pre-war conditions the larger producers could perceive little direct advantage in co-operative methods, the greater stress of post-war conditions has induced even the biggest farmers not only to join co-operative societies for trading purposes but to take a definite lead in their formation and development.

The advantages of this change of attitude on their part are far-reaching. To the mind of the average farmer theoretical considerations and logical deductions make little appeal unless they are backed by the opinion of those whom he knows and trusts. The best propaganda speech that can be delivered at any farmers' meeting held in the cause of agricultural co-opera-

tion consists in the utterance of a single sentence from the lips of the leading farmer in the neighbourhood to the following effect:—"I used to think that this agricultural co-operation was all nonsense, but now I am going to back it and put my money into it." The small producers readily follow the lead of the big farmers, and it is noteworthy that a very high proportion of the membership of the largest and most successful farmers' societies consists of men farming less than 50 acres, and that even those societies which consisted mainly in the past of comparatively large farmers are daily increasing the small producer element, and are developing the system of local depots, with branch advisory committees, which are needed to meet the requirements of those who cannot afford to buy in truck-loads. Indeed, the small farmer must be linked up with the large farmer if he is to obtain the maximum benefit from co-operative purchase and sale, as the larger the bulked trading transaction the greater the possibility of substantial savings in cost.

Influence of the War on Co-operation.—The fact is that the agricultural community of this country is being driven into co-operative methods by the sheer force of circumstances, and is recognising the need for developing its commercial organisation on the lines which are proving most successful in other forms of business enterprise. The prodigious and necessary expansion of the wage bill, the huge increase in the cost of feeding stuffs, fertilisers and other raw materials, and perhaps more than all the new consciousness on the part of the consumer of his rights as a consumer and of his difficulty in coping with the high cost of living, have forced the farmer to realise that he can afford to neglect no means of cutting down the cost of production or of effecting savings in the handling, distribution and marketing of his produce. The root causes, therefore, of the extraordinary growth of the co-operative movement during the past twelve months are to be traced to conditions which arise directly out of the changes effected by the War, and the Agricultural Organisation Society does not claim more than the provision of a well-planned lay-out and effective machinery, for which the motive power has been supplied by the farmers themselves.

England v. Denmark.—The historian of the future will perhaps be more interested in examining the defects which the spread of agricultural co-operation has revealed than in describing its actual growth and development, and indeed the diagnosis and remedial treatment of these defects is essential to the health of

the movement at the present time. Those who are most closely acquainted with agricultural co-operation as practised in Denmark will perhaps be surprised to learn that the most salient need of the co-operative movement in England and Wales is capital. In Denmark, where the dual system of landlord and tenant has given way to that of the owner-occupier, and the farmer consequently is in a position to borrow capital on ample security, co-operative societies make no demand upon their members for share capital and have proved themselves able to flourish on borrowed money pending the accumulation of adequate capital out of profits effected by savings in the conduct of their business. It is sometimes forgotten that capital accumulated in this way is gained at the expense of the farmer members, who have to pay more for their raw materials or receive less for their produce, as the case may be, in order that the interest on the borrowed capital may be paid and that a sufficient margin may be carried by their society to reserve. The Danish farmers are consequently providing capital by a system of deferred payments.

In this country, on the other hand, where the average farmer can provide his society with no security on which money can be borrowed, and where the banks are, rightly or wrongly, less accommodating than in Denmark, the conditions of co-operative trading approximate more closely to those under which ordinary commercial businesses are conducted, and the provision of adequate capital for working purposes, no less than to cover the provision of buildings and equipment, is essential to the development of a successful co-operative society. A committee of farmers with little previous experience of organised commerce is naturally apt to underestimate the proportion of working capital required for trading purposes, and it too often happens, also, that when a difficulty is encountered in raising the full amount required to start a society on the proper lines the promoters are tempted to begin with too little capital and to rely overmuch on borrowed money.

The Agricultural Wholesale Society.—Apart from the question of finance the main desideratum in the co-operative movement at the present time is to secure better cohesion not only between the societies and their individual farmer members, but also between the societies themselves. The individual farmer is still too ready to forego the ultimate advantages of co-operation in his anxiety to make an immediate profit, and is constantly liable to fall an easy prey to temporary undercutting on the part of

a competing trader. The societies, also, have not yet fully grasped the value of combined purchasing and selling through their central trading organisation, the Agricultural Wholesale Society. There is evidence of a marked improvement in this respect in the fact that the turnover of that society increased from £276,000 in 1918 to nearly £2,000,000 in 1919, but even that figure represented barely 20 per cent. of the total turnover of the affiliated societies in the commodities which the central society is in a position to obtain for them. The whole of the shares of the Agricultural Wholesale Society are held by affiliated co-operative societies, so that it is in fact as well as in theory the central trading federation of the societies, and not an independent organisation of whose services they may or may not avail themselves.

Co-operative Disposal of Produce.—As this country is not an exporter of agricultural produce, and has built up in the course of generations a highly developed system of internal markets, it is natural that the co-operative movement has made more progress in the combined purchase of the raw materials of farming than in the disposal of produce. Nevertheless, in certain directions this aspect of the business is now developing rapidly. The combined turnover of the co-operative dairy societies in England and Wales last year in milk and milk products approximated to £5,000,000, and now that the dairy industry is decontrolled and State restrictions have been removed a remarkable expansion of the co-operative movement in dairying is in progress. The co-operative handling of home-produced wool is being carried out this season on broad lines which will enable the farmer through his society to place his wool direct on the world's markets and to obtain full value for it. The latest returns indicate that not less than 200,000 fleeces, collected, weighed and classed by the co-operative societies, will be sold on the London wool market during the next few months. The disposal of home-grown meat, also, is being revolutionised through the gradual adoption by the farmers of the dead weight system, under which their cattle, sheep and pigs are slaughtered at co-operative abattoirs and sold to the best advantage in local markets and in the big consuming centres. There are now some 25 such co-operative abattoirs in full working, extending from Berwick-on-Tweed to the borders of Cornwall, and arrangements are far advanced not only for marketing the meat and edible offals but also for converting inedible offals and waste into valuable by-products such as fertilisers and feeding stuffs.

Relationship between Producer and Consumer.—It is not unnatural that some of those who have watched the development of agricultural co-operation in this country during the past two years have expressed anxiety lest the movement, in advancing the interests of the farmer, should be directed against those of the consumer. The exploitation of the consumer has at no time been a feature of the co-operative policy, and, indeed, any attempt in that direction would necessarily defeat itself. High prices and restriction of output are as dangerous to the producer as to the consumer, and the real object of the farmer is to organise the purchase of his materials and the disposal of his produce in such a way as to enable him safely to increase his production and work his land to its utmost capacity. The co-operative system brings him nearer to the consumer, and so tends to their mutual advantage.

Co-operative Movement and Allotment Holders.—One of the most striking developments of the agricultural co-operative movement during the past few years has been the phenomenal growth of the organisation of allotment holders. There are now upwards of 1,000 allotment societies affiliated to the Agricultural Organisation Society, nearly all of which are registered under the Industrial and Provident Societies Acts. The object of these societies is to acquire land for their members either by renting or by purchase, to carry on a co-operative trading business for the purpose of supplying their members with seeds, fertilisers and tools, and in many cases disposing of their surplus produce. and to regulate the cultivation and arrangement of the individual plots. Unorganised allotments are usually an eyesore to the community, but this can easily be avoided by careful planning and the enforcement of a few simple regulations. The co-ordination of the interests of allotment holders with those of the larger producers under the ægis of the Agricultural Organisation Society has had the happiest results, and is conducing towards a better mutual understanding of the problems and interests of town and country which is of real national benefit.

Co-operative Movement and Small Holders.—The organisation of the small holders, so far as concerns those who are dependent for their living on their farming operations, is a different and, in some respects, more difficult problem. The development of small holdings was necessarily retarded by the War and, as respects civilian applicants for holdings, is still at a standstill. The settlement of ex-service men on the land is proceeding

steadily, and wherever these settlements include a sufficient number of holders to justify concerted action, co-operative societies are being formed to undertake the supply of requirements and the marketing of produce. Isolated small holders are encouraged to join the farmers' societies. In the latter case no difficulty is experienced in obtaining effective service, but the societies that are composed exclusively of small holders are often hampered from turning their produce to the best advantage by the lack or cost of adequate transport facilities, and progress in this direction must necessarily be slow until a radical improvement is effected in the transport system of the country.

The tide will not turn in the agricultural co-operative movement, which is now firmly established as the natural business agent of the agricultural community. The fortunes of individual societies will vary in accordance with the degree of foresight, prudence and imagination exercised by those who are responsible for their direction, with the efficiency of their actual management, and with the loyalty and financial backing of their members; but the future of agricultural trading in this country now rests with the producers themselves.

THE WORK OF AGRICULTURAL EXECUTIVE COMMITTEES SINCE THE ARMISTICE.

AFTER the Armistice, when the compulsory breaking up of grass land ceased, Agricultural Executive Committees devoted their energies to the task of levelling up and improving the general standard of farming in their respective counties. The Committees retained, and still retain, all the powers that were exercisable by them during the War under the Defence of the Realm Regulations, but for the last eighteen months Cultivation Orders have been served only where the rules of good husbandry were not being observed, or where in other respects land was being neglected; for example, in regard to the maintenance of dykes and drains.

Enforcement of Cultivation Orders.—Cultivation Orders usually specify a date by which the work is to be completed, and where the work is not carried out, the defaulter may be prosecuted if the authority of the Ministry be obtained.

Among interesting cases where legal proceedings have been taken are the following:—

(i.) In East Suffolk 33 acres of good corn-growing land were bought in 1918, and the purchaser turned out the tenant, a good farmer, after asking a rent which was more than the land was worth. The land was then allowed to lie idle and become derelict, in spite of the service of Cultivation Orders by the Agricultural Executive Committee. The owner was therefore prosecuted for failure to comply with the Orders, and fined £20, or, in default of payment, six weeks' imprisonment.

(ii.) A notice to plough six acres of land was served on a farmer in Worcestershire in August, 1919, but no action had been taken by him up to February, 1920. It was shown that the land had lain derelict since the 1918 harvest, and about £80 worth of food was lost to the nation. The defaulter was prosecuted and fined £10 and £2 2s. costs.

(iii.) An owner of land in Somerset was prosecuted for failing to comply with a Cultivation Order served in June, 1919, requiring the land to be ploughed and cleaned by the 2nd September. The defendant's solicitor pleaded guilty on behalf of his client, but urged in extenuation of the offence that the land was purchased with the object of selling it again, not with the intention of cultivating it, and that delay had occurred in

finding purchasers suitable to his client. The Bench imposed a fine of £25, with £10 10s. costs.

(iv.) A prosecution for disregard of Cultivation Orders issued by the Surrey Committee resulted in the occupying owner of the land being fined £50 and his agent £10. The Orders in question were issued in October and November, 1918, and required that certain arable fields should be cleaned and cultivated in preparation for food crops for the harvest of 1919. Practically nothing was done, however, to carry out these Orders up to the end of 1919.

(v.) An occupier of a field of 23 acres in Kent was recently prosecuted for failure to comply with a Cultivation Order. The field contained a large quantity of thistles, brambles, gorse and anthills, which the occupier was instructed to remove and destroy. The thistles were dealt with, but very little action was taken to remove the other rubbish which encumbered a large proportion of the field. The defendant was fined £20 and £5 5s. costs, and has been served with a further Order to carry out the necessary work.

The problem of farms bought by speculators presents great difficulty, as Cultivation Orders have to be served on the "occupier," and in cases where the land changes hands frequently it is not always easy to ascertain who is legally the occupier at a particular time, in order to serve him with the notice.

Several prosecutions for failure to clean ditches have taken place in Norfolk. In one case the Order was served in May, 1919, and had not been complied with by March, 1920, and the defendant was fined £10 and costs. In another case the neglected ditch contained poison in the form of deadly nightshade, by which a horse and two young cattle were killed. A fine of £5 4s. was imposed.

There is no record of the total number of Cultivation Notices served by Agricultural Executive Committees, but it amounts to many thousands, leaving out altogether "Grass-ploughing Orders," which were served with the express object of increasing the arable acreage as a war measure.

Determination of Tenancies.—Under Article (1) (f) of Regulation 2M, the Ministry may determine the tenancy of an occupier of land who by reason of incompetence or persistent neglect shows that he cannot make proper use of his land. This drastic step is only taken after repeated warnings, and usually

after several Cultivation Notices have been served without effect. The notice may be nullified if, on appeal by the tenant to arbitration on the question whether the holding has been properly cultivated, the arbitrator takes the view that it has been. It is of interest that out of 20 cases where the tenant exercised his right of appeal the decision was against the tenant in every case. The total number of Determination Notices issued since January, 1917, is 809, relating to an area of 61,000 acres. The following may be quoted as examples :—

(i.) A farm of 19 acres in Buckinghamshire was under observation for a considerable time, there being gross and studied neglect on the part of the tenant. In 1918 part of the farm was ploughed up, the work being carried out by horses and men supplied by the Agricultural Executive Committee, and the resultant crop of oats was stated to be the best crop seen in the district. No preparations were made by the tenant to harvest the crop, and on being asked whether he required assistance he replied that he was not going to have the oats cut. Subsequently he allowed his cattle to stray in the field while the crop was still standing, and he was convicted and fined under the Growing Corn (Crops) Order, 1917. The 1919 crop was a failure, and this was apparently due to the unhusbandlike manner in which the lands were cultivated. The Ministry accordingly issued an Order determining the tenancy of the farm in February, 1920.

(ii.) The tenant of a farm of 150 acres in Worcestershire was served with Cultivation Orders, which he ignored. An independent report showed that the greater part of the arable land had not been ploughed for a considerable period, and that the grass land, which was poor, needed manuring. The tenancy was determined in February, 1920.

(iii.) In Northamptonshire the tenancy of a farm of 242 acres was determined about the same time. In this case the pasture land was badly grazed, and not one of the four hay stacks had even a layer of straw to protect it. The 1919 crop had not been threshed, and the arable land generally was in a deplorable condition. The fences and ditches were also in a bad condition. The occupier required the notice to be referred to arbitration, and the arbitrator found that the farm had not been cultivated according to the rules of good husbandry; the appeal therefore failed.

(iv.) Two holdings were let to a farmer in Derbyshire. Cultivation Orders were served upon him in respect of one of the holdings, but the tenant, who had taken the holding early in

1919, had sold the crops standing and made no attempt to cultivate the land. The Committee secured the conviction of the tenant for failure to comply with one of the Cultivation Orders, and also determined his tenancy. In the other case the prosecution was withdrawn.

(v.) The arable part of a farm of 81 acres in Herefordshire was found to be in a foul condition, fences and ditches were bad, and the greater part of the farm was in a neglected state. The tenant did not appear to be capable of improving the cultivation of the land, and the tenancy was therefore determined.

(vi.) The tenancy of five fields in the West Riding of Yorkshire was determined owing to the neglected condition of three arable fields comprised in the holding. The tenant had had several Cultivation Orders served upon him, and received many warnings, but he persistently refused to make any attempt to improve the cultivation.

(vii.) In September, 1918, a Cultivation Order was served on the occupier of a 216-acre farm in Buckinghamshire. It was practically ignored, and much of the land was found in March, 1920, to be in a foul condition, with the ditches in great need of attention. An Order was issued determining the tenancy, owing to the land not having been cultivated according to the rules of good husbandry.

(viii.) An Order determining the tenancy of a farm of 105 acres in Flintshire was issued in February last. The occupier held another farm, and had allowed this one to get into a deplorable condition. Couch grass and weeds had been mown and made into hay, there had been no attempt to cultivate the land, and the fences had been neglected for years. The occupier appealed to arbitration as to whether the farm had been cultivated according to the rules of good husbandry. The award was against him, and he had to pay the costs.

(ix.) Another instance in Wales was that of a farm of 262 acres in Glamorganshire, which was described as thoroughly foul, and on which the fencing was so defective that the stock wandered from field to field, damaging growing crops.

Entry on Lands.—In some cases, where no other course seemed possible to ensure proper cultivation, Committees have entered into possession of land and either farmed it themselves or let it to tenants. An article describing typical examples of action on these lines appeared in the issue of this *Journal* for June, 1919, and an account of the general results appeared in the April issue of this year, as well as a note in the March

number describing those farms which were cultivated entirely by women of the Land Army.

Where satisfactory arrangements can be made for future cultivation, the land taken over under Regulation 2M is being relinquished, while in other cases the farms are being used as training centres for ex-Service men. In a few instances the land has been acquired for purposes of land settlement, and in Worcestershire one farm taken over and brought into a good state of cultivation by the Agricultural Executive Committee is now being utilised as a Farm Institute in connection with agricultural education.

Special difficulties are being experienced in connection with derelict building estates taken over in Essex, Kent and Sussex. These consist of areas of agricultural land which have been sold in small plots for building purposes, but have never been built upon. Much land of this kind was taken over during the War and brought back to cultivation after many years of neglect. Isolated plot holders are now applying for the release of their plots for building, and owing to the shortage of houses and the compensation that would be payable if these plots were retained contrary to the wishes of the owners, the policy of the Ministry is to vacate such of the land as is required immediately for building. Great difficulty must inevitably result in carrying on the cultivation of the rest of the land when isolated plots, with the necessary access, are relinquished.

One such building estate in Sussex has produced remarkable crops, although at the time of entry by the Committee in 1917 it was practically derelict. There are no farm buildings, and the cultivation has been carried on with excellent results under very adverse circumstances. It affords a striking example of success in continuous corn cropping with the abundant use of artificial manures, and great credit is due to the Executive Committee and its officers for their skilful management of the enterprise. Owing to the demand by many of the plot-owners to have their land back in order to build on it, this estate is to be relinquished after the growing crops have been harvested.

The difficulties experienced by Agricultural Executive Committees in dealing with cases of gross negligence and incompetence are exemplified by a case in Durham. This farm was in a notoriously dilapidated condition, neither the owner nor the occupier (both of whom resided in the farmhouse) being capable of farming it properly. The service of Cultivation Notices had not the slightest effect, although the tenant was prosecuted and fined for negligence. The Committee also made unsuccessful

efforts to persuade the owner to let the farm to a capable tenant, and finally, with the approval of the Ministry, took possession of the land and began to cultivate it, the owner and occupier being left in possession of the farmhouse. The owner and occupier obstructed the Committee and threatened violence, and for this they were summoned and each fined £25 and £10 costs. The land has now been let by the Committee to a tenant who has made good progress with the cultivation.

A farm of 216 acres in Kent was taken over early in 1917 in a deplorable condition, having been occupied by a tenant with no knowledge of farming. The tenant was allowed to remain on the farm as foreman under the instructions of a supervisor appointed by the Committee, and the Ministry's technical expert reported in August, 1918, that a "marvellous transformation" had taken place in the cultivation, in spite of the handicap of an inefficient foreman. The tenancy was subsequently determined, and the farm is still in the hands of the Committee.

In Warwickshire a farm of about 450 acres was taken in hand in 1917. 300 acres had not been farmed for thirty years, and the land was overgrown with thorn bushes and infested with rabbits. Prisoner of war labour was obtained, and under the efficient management of a member of the Executive Committee the whole farm was brought into a good state of cultivation. It has recently been sold, and out of the purchase money the Ministry has by arrangement been paid the sum of £2,400, which will go to recoup the money expended in reclaiming and cultivating the land.

Very successful results have attended the cultivation of a large area of derelict glebe land in Cambridgeshire. The proper treatment of this land was rendered very difficult by the absence of buildings, and the land was overgrown with bushes and required a great deal of labour to bring it into cultivation. This has now been accomplished, and excellent crops of corn have been grown.

In this and other cases where Agricultural Executive Committees have cultivated derelict land, the value of their work has consisted in a large degree in exemplifying the practical application of scientific and up-to-date principles to the management of neglected and naturally poor land.

Members and officers of Agricultural Executive Committees have given much time, as well as practical knowledge and ability, to the task of making a success of what has been, in many cases, a somewhat hazardous experiment, and it is confidently hoped

that their labours, begun under the difficult conditions which prevailed during the War, will have a permanent influence in raising the standard of cultivation in the districts where the possibilities of improvement have been demonstrated in a practical way.

It may be added that the area of land still in possession of Agricultural Executive Committees is about 82,000 acres, of which 20,000 acres are farmed direct and 12,000 acres are let to tenants. A great part of the land will be given up next Michaelmas. The Agricultural Executive Committees, as such, will shortly disappear, and the powers which they now exercise on behalf of the Ministry will be transferred to the County Agricultural Committees that have been recently set up under the Ministry of Agriculture and Fisheries Act, 1919.

FARMYARD MANURE: ITS MAKING AND USE.*

Nor many years ago it used to be the custom for certain representatives of agricultural science to extol the virtues of artificial manures, while farmers, on the other hand, stoutly maintained the superiority of farmyard manure. In recent years the position has changed. It is now the scientific worker who emphasises the importance of farmyard manure and the need for making and storing it properly. Farmyard manure and artificial fertilisers do not compete with one another; they serve quite different purposes in the soil. No farmer can do without artificials, no matter how much farmyard manure he may have at his disposal. and, conversely, no arable farmer, except in a few special districts, would like to do without farmyard manure, even if he could have unlimited supplies of artificials at very low prices. The best results are always obtained on arable land by proper combinations of farmyard and artificial manures, although on grazing land farmyard manure may not act well.

So far as is at present known, the effects produced by farmyard manure in the soil are three:—

1. To supply nitrogen and potash to the plant.
2. To improve the physical condition of the soil, and thus increase its capacity for going into a good tilth and for holding water. The effect of this is to steady the yield.
3. To assist some of the micro-organisms of the soil; among other effects, to benefit the clover crop.

Only in the first of these is there any competition with artificial fertilisers, and even here the competition is restricted, because artificials usually exert their full action on the crop to which they are applied, while farmyard manure does not.

The Constituents of Farmyard Manure.—1.—*The Excretions*—The animal excretions constitute an important part of the fertilising material of farmyard manure. The urine is by far the most important—it is the chief source of the immediately beneficial part of the dung. The amount and value of the urine depend on the food and on the animal; urine contains the fertilising constituents of all the digested food which has neither been retained in the animal nor secreted in the milk.

Its composition can be calculated, and this is done in determining the manurial value of foods, but the calculation never

* Reprint (abridged) of a paper read by Dr. E. J. Russell, F.E.S., Director of Rothamsted Experimental Station, at a meeting of the Farmers' Club, 31st May, 1920.

comes out quite right, because its valuable constituents are so easily decomposable that they are readily lost.

Although the dry matter of the urine forms only about 2 per cent. of the actual weight of the dung, it constitutes a much larger proportion of the weight of fertilising materials. A ton of dung contains about 12 to 15 lb. of nitrogen, of which about 4 to 9 lb., according to the amount of cake and corn fed, would come from the urine.

2. *The Litter*.—Straw is by far the commonest litter, and it forms the chief part, by weight, of farmyard manure. Broadly speaking, one ton of straw makes 4 tons of farmyard manure, but the additional 3 tons is very largely water, only a small part being other excretory substances. Of 100 parts of farmyard manure made in a bullock yard:—

75 are water.

About 2 are solid constituents of the liquid excretions.

About 8 are constituents of the solid excretions.

About 15 are constituents of the litter.

On the basis of bulk, therefore, litter is more important than anything else, although not in other respects. Its chief effect is that it forms the humus in the soil, and therefore helps to promote tilth and to improve the water-holding capacity. Unfortunately, its change into humus is expensive to the farmer in that the organisms effecting the change take up valuable nitrogen compounds from the urine that ought to have gone to feed the crop.

The Making of Farmyard Manure.—The simplest case is that of manure made from fattening bullocks in stalls or covered yards where the manure is of considerable value, and where pains are commonly taken to preserve it. Of every 100 lb. of nitrogen fed to the animals, about 95 lb. pass into the manure—often about 45 to 60 lb. in the liquid and 50 lb. to 35 lb. in the solid excretions. The 45-60 lb. are in a form highly valuable to the plant. The decomposition process, however, takes rather a heavy toll, in one way or another about 15 lb., leaving 30 to 45 lb. in a form really useful to the plant. The nitrogen in the solid, and such of this 15 lb. as is not altogether lost, may at some time become useful to the plant, but it does not count for much: only the 35 to 40 lb. balance can be relied upon to yield any profit.

When, as often happens, the manure is made in open yards, the loss becomes more serious. The minimum loss of 15 per cent. is exceeded, often much exceeded, and, as always, it falls

on the most valuable part of the nitrogen. It is probably not far wrong to suppose that the manure from a bullock receiving 3 lb. of cake and upwards per day is worth 15s. or more per month when made in a covered yard, but not more than some 10s. or 12s. per month when made in an open yard. For a herd of twenty bullocks, the loss in manurial value through having no roof to the yard may be any amount up to £5 per month.

It is often maintained, however, that some rain is necessary, as otherwise the manure becomes too dry. While a certain amount of moistness is necessary, rain may seriously damage the manure by washing out some of its valuable constituents and by bringing about certain undesirable changes. It is probably better to keep rain away from the manure and to ensure sufficient moisture by reducing the area over which the animals can wander, thus obtaining a high proportion of excretions among the litter. The comfort and well-being of the animals, however, must always be the first consideration. Periodically pumping liquid manure or water over the heap is not to be recommended.

Storage of Farmyard Manure.—In the matter of storage the Northern farmer has some advantages over his colleagues in the South, one of which is that he can, as a rule, advantageously apply farmyard manure to his land in the spring. Manure made in the yards during winter can thus be hauled straight on to the land and ploughed in with reasonable certainty that this is the best thing to do. The Southern farmer, on the other hand, while he may be driven to spring applications of farmyard manure, would often obtain better results by applying the manure in the autumn. The storage of farmyard manure over the summer months thus becomes an important question.

However carefully matters are arranged, directly the manure is drawn from the yards some of its really useful nitrogen—the 30-lb. balance—begins to leak away. It forms part of the odour that gave the old farmers so much satisfaction. It enters largely into the black liquid, which, even in a well-conducted farm, is often seen draining away from the manure heap. Both smell and liquid are signs of leakage; but they do not represent the whole of the loss. It is wrong to suppose that matters can be put right by simply replacing the black liquid; its very existence is a symptom that bigger losses are taking place.

Many attempts have been made to obtain a reliable estimate of the amount thus lost. In experiments at Rothamsted the losses varied from 7 per cent. to 35 per cent. of the total nitrogen. A common loss was about 20 per cent., falling chiefly on the urine

nitrogen. Assuming this latter figure were generally true—and we have no reason for supposing otherwise—our 90 lb. of valuable nitrogen would soon be reduced to little more than 10 lb.—*i.e.*, 85 per cent. of the original nitrogen, or 75 per cent. of the most valuable portion, has disappeared.

Loss in Farmyard Manure.—It has often been suggested that kainit, gypsum, superphosphate, or other substance added to the manure helps to reduce the loss by fixing ammonia. The processes bringing about the loss, however, are too complex to offer any reasonable expectation of the discovery of a satisfactory fixer.

It is difficult to form any estimate of the loss which occurs to farmyard manure over the whole country, but it must be considerable. Taking the present consumption of straw in the farm buildings of the United Kingdom to be about 10,000,000 tons per annum, the production of farmyard manure would be 40,000,000 tons, worth at present prices some £25,000,000 or more. The loss in making and storing the manure heap is not less, but probably more, than 20 per cent. of this, *i.e.*, more than £5,000,000 each year.

This loss cannot altogether be avoided, because it is part of the cost of the necessary decomposition of the straw, but it can be much reduced. In experiments at Rothamsted the provision of shelter to keep off some of the rain much increased the effectiveness of the heap.

Shelter can be provided in several ways. A layer of earth has proved effective, but it is not always convenient. Straw-thatched hurdles acted well in the trials. Placing the heap in a well-sheltered position is also helpful.

At present prices it is probably safe to suppose that an amount from 1s. to 5s. is added to the value of every ton of manure by providing shelter.

The Feeding of Cattle.—There has been considerable discussion as to the extent to which cake-feeding adds to the value of farmyard manure. In recent experiments the additional value due to the cake was less than was expected, and the benefit of the cake was shown only in the first year, and not afterwards. The practical man, however, holds fast to cake-fed dung, and recent experiments at Rothamsted have shown a direction in which it may be superior to ordinary dung. The breaking up of the litter to form humus is brought about by organisms which require the sort of nitrogen compounds that they would find in cake-fed

dung; they would, therefore, be able to work more vigorously in cake-fed dung than in ordinary dung, and hence would tend to produce better soil conditions.

The evidence indicates that cake feeding produces less benefit than might be expected on soils where plant food only is needed, but more benefit on soils where additional humus is necessary.

Cow Manure.—The question of cow manure is complicated by the necessity for satisfying sanitary inspectors, and by the fact that it is of poorer quality than bullock manure.

The poverty of cow manure arises from the fact that a cow secretes a considerable proportion of the nitrogen of the digested food in the milk instead of passing all of it into the urine like a bullock. The urine is, therefore, weaker than in the case of bullocks, and there is a corresponding reduction in the value of the manure.

On some of the Oxfordshire farms a big covered shed is built next the cattle-shed for the storage of manure. The principle is sound, but the plan is sometimes inconvenient in execution. In Cheshire one sees good dungsteads—roofs of corrugated iron carried on stout posts, and so placed that the dung can easily be tipped underneath and then compacted. These are of great value, but care must be taken that the manure is sufficiently well compacted to prevent it becoming too dry.

Cow manure, however, presents an interesting possibility, because so much of the liquid is or can be collected separately, and this should certainly be done wherever practicable. The liquid is very valuable, containing as a rule about 18 lb. to 23 lb. of nitrogen per 1,000 gallons, besides possessing a high potash value.

A suitable dressing is 1,500 gallons per acre, and it serves excellently for seeds and as a spring application for winter oats or winter wheat. On an average each cow contributes about $1\frac{1}{4}$ gallons of urine per day,* which is worth about 2s. 6d. per month. The difficulty at present is to apply this material.

Artificial Farmyard Manure.—As the bulk of farmyard manure is litter, and the valuable part of the residue is largely made up of liquid excretions, it is not difficult for the scientific investigator to make an artificial farmyard manure from straw and artificial fertilisers. This has been done at Rothamsted,* and one or two tons of the product were tried on the field. It is

* Both at Woking and at Garforth, however, Collins gives 5 gallons containing 1 lb. of dry matter as the figure for the north.

too early as yet to say whether the material will work out economically in practice, but the principle is sound; it consists in allowing the straw to decompose with formation of humus, and supplying the necessary nitrogen compound in the form of an ammonium salt. When the details are worked out the method may probably prove of interest in districts like the Rothings, in Essex, where quantities of straw are produced but no live stock is kept, and yet where farmyard manure ought to be used.

Possibilities of Improvement.—The possibilities of improving bullock manure lie in the following directions :—

1. To make it in a covered vard, having sufficient beasts to keep the manure moist.

2. To put it into the ground as soon as possible after the beasts are removed; but, if this is impossible, to make a tight clamp and provide some shelter by a layer of earth or by some other device.

3. To avoid washing by rain or exposure to weather.

The defects of the clamp, even when compacted and sheltered, are recognised, and science has not yet said the last word as to the storage of manure; but for the present it is the only practicable method.

The improvement of manure from cowsheds can be effected :—

1. By collecting the liquid separately in a cement tank.

2. By storing the solid in a covered dungstead, to which can also be added manure from the horses. It is necessary to compact the heap. Provision must also be made for a tank to collect drainage.

The application of the liquid to the land, however, is a difficult problem. The method of distributing the liquid over the farm by means of pipes has been tried, but has resulted in financial loss. Something can be done by delivery from carts, but the most helpful line is the use of absorbents, which is now being investigated at Rothamsted. This is an important problem, and it will grow in importance if the soiling system of keeping dairy cows develops in this country.

THE DECLINE IN SHEEP BREEDING.

SIR HENRY REW, K.C.B.

*THE subject I am invited to bring before you for discussion is that of "the depletion of the breeding flocks of the country and the lessened production of cereal food resulting therefrom." That is a practical subject, and I need not say that I have no pretension to speak upon it from a practical standpoint. But the subject also involves the consideration of statistical facts and economic tendencies to which I have given some attention, and it is to these that I shall confine myself in the hope that they may be of some help in the subsequent discussion.

Decrease in Numbers.—It is a sound principle—not invariably adopted in public controversy—to ascertain the facts before drawing conclusions. That there has been a reduction in the number of sheep in this country is notorious; but it is desirable at the outset to obtain some measure of its extent. The agricultural returns which are collected annually in June afford the only measure we have, and they give us the number of sheep in the country year by year for over fifty years. If we summarise these returns in quinquennial periods we find that the total stock of sheep in Great Britain has varied as follows, the numbers representing millions :—

1870-4	...	...	28·6	1895-9	...	...	26·6
1875-9	...	...	28·4	1900-4	...	...	25·9
1880-4	...	..	25·3	1905-9	...	...	26·3
1885-9	...	...	25·8	1910-4	...	...	25·4
1890-4	...	...	27·6	1915-9	...	...	23·7

Leaving out of account the war period, which we will consider later, these figures would seem to indicate not only that the flocks of the country after the disasters of the early "eighties" never recovered the position which they held in the "seventies," but that during the present century they had fallen substantially below the standard of the "nineties." There is, however, a disturbing element which materially affects a comparison over a long period of returns which represent the enumeration at a fixed date each year of the total number of sheep then living. The age at which sheep are slaughtered is on the average now consider-

* An address delivered at the Darlington Conference of the National Sheep Breeders' Association on 29th June, 1920.

ably less than it was fifty years ago. The four-year-old wether which used to represent the highest standard of mutton production is now very seldom seen at table, and probably would not be appreciated by the present generation if it were. Early maturity has been adopted as a principle which suited at once the interest of the producer and the taste of the consumer. It is evident, however, that with the progressive adoption of this principle the number of sheep returned each year would decrease, even although the actual number bred were maintained. Since 1893 the annual returns have given the number of breeding ewes separately from other sheep. The average numbers of ewes so returned during the past 25 years, in millions, were :—

1895-9	...	...	...	...	10.0
1900-4	...	...	...	...	10.1
1905-9	...	...	...	...	10.3
1910-4	...	...	...	...	10.1
1915-9	...	...	...	...	9.6

It will be seen that the breeding flock in the five years before the War, though showing some decline as compared with the preceding five years, had been fairly maintained at the level of the ten years previous. In fact, if the returns are examined year by year it appears that the number of breeding ewes in each of the three years 1908-10 was higher than in any year for which we have records, and that although the number fell from a maximum of 10,810,000 in 1909 to a minimum of 9,613,000 in 1913, there were signs of recovery when the War broke out, and one-half of the loss had been made good by June, 1916.

Effects of the War.—This brings us to a consideration of the effects of the War upon sheep-breeding and to the question as it now confronts us. The returns for June, 1914, represent the pre-war position, and it will be useful to state the figures for that year and for each succeeding year up to 1919, the returns for the present year being not yet available.

The number of breeding ewes and of other sheep, with the total returned for Great Britain in each of these years, the figures again representing millions, were :—

	<i>Ewes.</i>			<i>Other Sheep.</i>			<i>Total.</i>
1914	9.8	...	...	14.5	24.3
1915	9.9	...	...	14.7	24.6
1916	10.1	...	...	14.9	25.0
1917	9.9	...	...	14.1	24.0
1918	9.5	...	...	13.9	23.4
1919	8.6	...	...	12.9	21.5

Up to June, 1917, there was no cause for alarm, as although there had been a reduction of a million in the total, the breeding flock had been but slightly affected, and was indeed slightly larger than in 1914. The serious depletion commenced after June, 1917, and in two years the total number of sheep declined by 10 per cent. and, what is more ominous, the breeding ewes decreased by over 18 per cent.

I have already indicated that the number of sheep in the country has always been subject to considerable fluctuations, attributable to the effect of season on the lambing and on the supply of keep, to the trend of prices for mutton and wool and sometimes to the outbreak of disease. In the two years 1879-81, for instance, we lost $3\frac{1}{2}$ million sheep, mainly as the result of bad seasons and disease. But it is evident that we must look further for the cause of the losses since 1917.

There are three factors to which the recent decline of sheep breeding has been attributed; all of them are exceptional and are due to the War.

- 1.—Special economic conditions.
- 2.—Control of prices, distribution and sale by the State.
- 3.—Extension of arable cultivation.

Control.—Abnormal economic conditions arose, of course, as soon as war broke out in 1914, and farming difficulties commenced early in 1915, when the shortage of labour and increased cost of feeding stuffs began to be felt. These difficulties progressively increased and became no doubt substantially greater after June 1917, than before. It was, however, at that period that the two other factors were introduced. The "plough policy" began to operate in the early part of 1917, maximum prices for mutton were fixed in September of that year, and in January, 1918, the official control of the sale and distribution of sheep commenced.

I do not propose to discuss the details of the control imposed by the State on the sheep-breeding industry. The system adopted was, of course, subject to some criticism on the ground that it might have been carried out in a different way with better advantage and less disturbance. Any system of the kind hastily improvised and necessarily entrusted to a large number of individuals temporarily engaged in administrative work of a novel character must in any case have had defects. Possibly experience might in the course of time have suggested improvements in detail and a better system might have been evolved. It is well, however, to be quite clear on this point and to recog-

nise that under the most perfect administrative system of control which could be devised the fundamental fact remains, that State limitation of prices and official control of distribution means, and must inevitably mean, the discouragement of breeding. In saying this I do not suggest that State control was unwise or was not required in the national interests under the circumstances of the time. The decision to fix maximum prices was a political decision, and in the case of sheep it was considered that official control of supplies and distribution was consequential on the fixing of maximum prices. I am not attempting to argue that issue, but it seems to me highly important to realise that any attempt to justify the system on the ground that it tended to maintain home supplies must fail.

I am well aware that the intervention of the State for the object of maintaining our flocks and herds was advocated, not only by the public, but even by farmers themselves at various times during the War. Pressure to take action in this direction and for this purpose began even in the autumn of 1914, and was very persistent in 1915 and in later years. In regard to the sheep-breeding industry the demand for restrictions on the slaughter of lambs or of ewes was from time to time clamorous. No doubt such demands had a plausible aspect to those who took only short views. But they overlooked the real point on which the maintenance of breeding depends. The question which determines whether the sheep stock of the country (apart from seasonal and accidental fluctuations) will increase or decrease is the decision of flockmasters every year as to the number of ewes they will put to the ram. If by some arbitrary decree they are compelled to sell off fewer sheep at a certain age or at a certain time than they would otherwise have done in the ordinary conduct of their business, their plans for making up the ewe flock will be altered, and the net result over the whole country will be that fewer ewes will be put to the ram and the stock of sheep will be consequently reduced. The fact is, that from the point of view of maintaining the flocks of the country the State must do one of two things—it must either leave the business alone or control it altogether. If the State chose to take over the management of all the flocks, with all that this implies, it could then determine—regardless of economic considerations—how many ewes should be put to the ram each year, and thus control production, so far as Nature allows. But unless it is prepared to do this the control of prices and of distribution must in the long run reduce the number of sheep kept.

Comparison of Decline in Grass and Arable Districts.—Whatever may be the causes of the serious reduction in the number of sheep which we are considering, it is clear that their effects have been much more marked in some districts than in others. Speaking generally, the arable counties have lost most heavily. Without going into details for each county it will suffice to compare the returns for two groups of half a dozen representative arable and grass counties. For the arable group let us take Cambridge, Essex, Lincoln, Norfolk, Suffolk, and the East Riding, in each of which the proportion of arable is between two-thirds and four-fifths of the farmed land. For the grass group let us take Hereford, Leicester, Northumberland, Somerset, Stafford and Warwick, in each of which the proportion of arable is one-third or less. So as to get a broad view let us take the year 1912, when the total number of sheep in the country was just over 25,000,000 and the breeding ewes 10,120,000. This represents a fair basis, rather on the low side, for what may be termed the normal stock of the country. In that year the two groups of counties I have chosen had each about 2½ million sheep. In 1919 the sheep in the arable counties had been reduced by 28 per cent., and in the grass counties by 13 per cent., while the arable land in the former group had been increased by 3 per cent. and in the latter group by 16 per cent. The “Down” counties, Dorset, Hampshire and Wiltshire, which would not fall expressly into either group, but form a typical sheep-breeding district, show in the same period a reduction of no less than 37 per cent. in their total sheep stock, the increase of arable land being 4 per cent.

On a superficial view of these figures it might be argued that an extension of the arable area involves a reduction in the number of sheep. That this would be a fallacy needs no argument from me before an assembly such as this. Not only is arable land necessary for the intensive production of mutton and lamb, but conversely, the keeping of sheep is, under normal conditions in this country, the most effective and economical means of keeping many classes of land under the plough and of maintaining and extending the area under cereal crops. If this fact appears to have been disproved by the fact that sheep declined while arable land increased, the explanation is to be found mainly in the incidents of control. While the cost of production increased on arable land to a much greater extent than on grass land, the arable sheep farmer was prevented from obtaining the higher prices for the lamb and mutton he produced

which they would have fetched in a free market. The relative values of farm produce being abnormal, it was often more profitable to sell fodder crops as hay than to feed them to sheep, or to substitute corn crops for fodder crops on land which would otherwise have helped to maintain the flock. I am, however, venturing upon practical questions which are better left to be dealt with in the discussion.

In conclusion, I will add only that if the importance of extending the arable area and increasing the production of cereals is recognised by the nation, it must also be recognised that one of the means which will assist in securing that end is to ensure that confidence is restored to the sheep-breeding interest, which has, for generations been in a large degree the mainstay of British agriculture.

OPEN-AIR PIG-KEEPING.

THE system of open-air pig-keeping has been carried out successfully at Tiptree, in Essex, by Messrs. Wilkin & Son, Ltd., who run a considerable herd of pedigree Large Blacks. The greater part of the ground (poor London clay) over which they run had long been allowed to fall into a bad condition, and when it was acquired a few years ago by Messrs. Wilkin, was not capable of raising good crops. To the pigs was entrusted the task of mending the land.

The animals are penned either with iron hurdles or chestnut pales, and Mr. S. Wilkin, who is in charge of the herd, finds that one acre will carry ten pigs for six months. Their shelter is of the slightest, either a three-wheeled hut which can be moved readily from one part of a field to another, or hurdles supported by posts and covered with some rough thatching material. The system of handling is to run and fold the stores and gilts like sheep and to run the sows in the pastures in charge of one foreman. The pigs are allowed to farrow in the open without attendance, and so far without casualty. They are kept as much as possible in even sizes and fed at several troughs, so that all may obtain a fair share of the small measure of concentrates given to them. Breeding is so arranged that the sows farrow in January and July, the theory being that the January-born pig is able to take advantage of the spring weather, and the July-born pig is able to grow strong before winter begins. For sows with a litter, up to 7 lb. a day of concentrated food are allowed. No ringing is practised; the pigs are not fed before being turned out, and being hungry and having plenty of space to cover do not trouble to root.

The methods of cultivation used are those that are often associated with the name of Mr. Wibberley, catch crops being raised throughout the year for the benefit of the herd. Rape, kale and clover seem to be the most useful food. Rye and tares are also used, but are not so much in favour. Mr. Wilkin claims that pigs graze more closely than sheep.

The meal ration consists of 40 per cent. palm-kernel meal, 10 per cent. fish meal, and 50 per cent. of such offals as are in the market. Pigs born at midsummer, 1919, wintered in November, December and January on rape with 4 lb. per head daily of the mixed meal and a fresh fold of rape every third day. In February they were put into an orchard under fruit trees and had an extra ration of 2 lb. of beans every week. In March they were run over young wheat and winter



FIG. 1.—Pigs just put on new Fold.



FIG 2.—Fold on Red Clover.

peas during the middle of each day. At 1 p.m. they were brought home and fed with a 4-lb. ration of the mixed meal. In April and May they were folded on rye, and ate it off much closer than sheep did. When it was not possible to fold them for a time during the winter, they received, in addition to 4 lb. of mixed meal, a few peas or beans. A 7-lb. ration for sows with litters appears to be the maximum allowance.

One of the most important factors in connection with this open-air pig-keeping is, of course, the benefit to the land. Mr. Wilkin claims that he can grow very heavy crops of corn, and that the whole agricultural position has been greatly improved. Before turning the pigs on, the land had to be cleaned and cultivated at a cost of more than double the purchase price, which, however, was very low. That the pigs respond to these conditions of open-air treatment there can be no possible doubt. Mr. Wilkin claims that many five-month gilts folded on rape and clover, with a 3-lb. daily ration, are fat enough to kill. The early January gilts farrow when 13 months old. There have been no cases of tubercle, and there have been no deaths in farrowing. Ordinary winter weather has had no bad effects, and sows have farrowed quite successfully under hedges in January.

A table showing feeding methods, material and prices is appended:—

	Ration per Pig per Week.		Cost of Meals and Peas per Pig per Week.		
	Meal	Peas	Meal	Peas	Total
	<i>Owley Hall.</i>				
30 Gilts, 20 weeks on Clover	lb. 7	lb. 4	s. d. 0 10½	d. 10	s. d. 1 8½
	<i>Culves Pasture.</i>				
49 Gilts, 12 to 14 weeks on Vetches ...	14	1½	1 9	3½	2 0½
	<i>Park Farm.</i>				
15 Gilts in-pig, on Mustard and Rape ...	28	—	3 6	—	3 6
Sows in-pig and with litters	49	—	6 1½	—	6 1½
	<i>Anchor Field.</i>				
25 Stores, Boars and Hogs, Rye Grass and Clover	21	1½	2 7½	3½	2 11½

Kind of Meal.	Price per Ton.	Price per Lb.	Percentage used in Mixture.
Fish Meal ...	£ 22 0	d. 2 8	10 per cent.
Barley Meal ...	24 0	2 5	20 "
Middlings ...	14 0	1 5	20 "
Palm Kernel Meal ...	7 10	—	40 "
Maise Germ Meal ...	16 10	1 7	10 "
100 lb. of above mixture costs 12s. 6d.			
1 lb. " " "	"	"	1½d.

ECONOMIC POSITION OF THE POULTRY INDUSTRY.

EDWARD BROWN, F.L.S.

THE poultry industry has made great progress during the last six years. Those who were engaged in the business of poultry keeping before the War, and continued under the trying conditions of shortage in feeding stuffs, are rewarded by the more favourable situation now existing. Even those branches of poultry keeping which were regarded as more or less experimental seem now to have established themselves, and there is a clearer appreciation of the food value of eggs and poultry than was the case before the War.

Eggs have increased in price to a greater degree than most other regular articles of food, and what has been of great importance to the producer is that prices have been high in the spring and summer months when production is at the maximum. The prices of poultry, however, have not advanced to an equal extent, although the price of ordinary farm fowls increased more than for specially fattened kinds. During the early days of the War there was almost an entire cessation in the demand for fatted poultry, and as a consequence fattening plants reduced their output. With the shortage in feeding stuffs in 1917 onwards, the trade became unprofitable, and as a result of the fixing of maximum prices at a little more than 100 per cent. higher than the pre-war rates for poultry of fine quality, a considerable number of poultry fatteners in Sussex and West Kent went out of business. At present there is little prospect of the restoration of the industry on a large scale, as there is not sufficient margin between cost of production and the market returns, to provide an adequate profit.

The raising of ducklings for market has also suffered to an equal if not greater extent. Geese, on the other hand, have grown somewhat in favour, regaining among industrial workers a measure of the popularity they had many years ago. No actual figures are available as to the reduction in the number of turkeys raised in recent years. As they are essentially farm stock, the extra cost of feeding and raising has not been so great as in other branches of poultry keeping, and the chief reason for the decrease which has occurred appears to be that farmers have found other undertakings more profitable. It should, however, be possible to raise the breeding of turkeys to its former position within a comparatively short period..

As an indication of values of eggs and poultry, the following index figures of prices, taken from the Weekly Market Returns of the Ministry of Agriculture for certain months of the years 1918-1919, are given.

INDEX NUMBERS OF LONDON PRICES.

Eggs.

	1918.	1914.	1915	1916.	1917.	1918.	1919.
February ...	100	100	125	142	208	324	430
May ...	100	100	120	147	211	378	350
August ...	100	105	122	153	210	366	335
November...	100	106	120	155	197	324	264

Poultry.

	1918.	1914.	1915	1916.	1917.	1918.	1919.
February ...	100	99	97	115	132	220	211
May ...	100	100	107	128	141	252	212
August ...	100	95	103	127	146	246	224
November..	100	89	108	128	157	225	212

The main factors in the increased prices of eggs and poultry, especially the former, are the great decrease of imported supplies. The following table, prepared from figures given in the Trade and Navigation Returns of the Board of Trade, gives the relative quantities of eggs and poultry imported in 1913 and 1919 respectively. In 1918 overseas supplies of eggs were about half the quantity of the imports during 1919.

Imports.

<i>Country.</i>	<i>Eggs, in Thousands of (<i>Gr Hundred,*</i>)</i>			<i>Poultry, dead* (in cwt.).</i>	
	1913	1919.		1913.	1919.
Russia ...	11,451	—	...	119,944	8
Denmark ...	4,265	1,638			
Germany ..	514	—			
Netherlands ..	977	—			
France ...	702	6	...	31,175	3,083
Italy ...	846	—			
Austria-Hungary	884	—	..	26,674	—
U.S. of America	6	1,409	...	54,242	100,512
Egypt ...	1,096	759			
Canada ...	2	1,477			
Other Countries...	835	355	...	46,430	43,964
	<u>21,580</u>	<u>5,644</u>		<u>278,465</u>	<u>147,567</u>
Decrease per cent.	—	73·8	...	—	47·0

* A great hundred of eggs = 120.

So far as prices are concerned, the average declared values* per unit of all imports work out as follows :—

	1918.	1919.	<i>Increase per cent.</i>	
Eggs, per great hundred	8s. 10½d.	30s. 6½d.	...	245
Poultry, dead, per cwt. ...	68s. 7d.	207s. 1d.	...	202

How far we may anticipate that imported supplies of eggs and poultry will increase to any great extent is a problem for consideration. It will naturally be determined by the extent to which foreign countries will be able to recover their former output, and the increase in the number of poultry kept in this country both for eggs, breeding and table purposes. The question of price and demand will necessarily be involved in the consideration of this problem.

In 1918, more than 94 per cent. of eggs imported into the United Kingdom were received from European countries. The future position must largely be determined by the extent to which this trade can recover, and a brief survey of the position in various countries may be instructive.

In 1918, 53 per cent. of the total imports of eggs into the United Kingdom were received from Russia. The prospects of export from Russia being revived are small, and as Germany was the largest buyer of Russian eggs and poultry before the War, it is probable that when trade is resumed again the bulk of supplies will find their way to that country.

In 1918, Danish eggs represented 19.76 per cent. of our total imports, but as a result of the War the number of fowls kept in Denmark have largely declined. Although in 1919 imports of Danish eggs consisted of 29 per cent. of the total imports of this commodity into the United Kingdom, the actual quantities received were less by 64 per cent. than in 1918. In pre-war days large quantities of Russian eggs were imported for consumption in Denmark, and in consequence of the cessation of this source of supply there has been a reduction in the quantity of home produce available for export. A rapid increase may be anticipated, although the prices obtainable in Germany may lead to a greater proportion being sent to that country.

The position in Holland is very similar. In 1918, 4½ per cent. of the total imports of eggs into the United Kingdom came from that country. In 1919 this figure has been reduced to only a small fraction of 1 per cent. It may be anticipated, however, that production will be rapidly increased, although Germany is

* The declared value is the value (cost, insurance, freight) as declared to the Customs Officers at the port of arrival.

likely to be a serious competitor for supplies. Formerly, all surplus poultry from Holland went to that country.

In 1913 France was responsible for $3\frac{1}{2}$ per cent. of the eggs imported into the United Kingdom, whereas in 1919 the supplies from this source were insignificant. The margin of eggs and poultry available for export was always relatively small, owing to high consumption at home, and it does not seem likely that any great supplies will be derived from this source.

The three countries which have sent the greatest volume of supplies since 1914 are Egypt, Canada and the United States of America. As far as can be anticipated, imports of eggs from Canada and Egypt will continue, unless prices fall very heavily, but it is unlikely that the United States will under normal conditions ship eggs to the same extent as during the War, although she may maintain export of poultry. The imports of eggs in 1919 from Egypt, Canada and the United States only represented 17 per cent. of the total imports in 1913, so that they do not present a serious factor in competition with the home market.

Large as were the imports in 1913, the actual quantities relatively to the population were small. Before the War 56 eggs per head of the population were imported, while in 1918 and 1919 the imports were respectively 7 and 14 eggs per head. There is therefore not only an imperative need for production to meet the shortage of imported supplies, but also to provide for an anticipated increased demand. At the last poultry census of which a report has been published (1908), there was only about three-quarters of an adult fowl per acre of cultivated land in England and Wales. In the opinion of the writer an increase of about one and one-third of the total number of adult fowls would make up for the reduction in imports.

The extent of the change since 1908 cannot be estimated. In 1917, when feed began to be scarce and dear, there was probably some reduction in the number of poultry maintained, but at the present time it is likely that an increased number of people are keeping poultry as compared with the number before the War.

Extension of production would be most easily attained upon farms, and the number of farm poultry could probably be increased threefold without causing displacement of other stock or interference with crops. Owing to the large amount of natural food obtainable by poultry on an open range, the costs of feeding and equipment are comparatively low, and this is the most economic and profitable method of production, whether of

eggs or table poultry. Its weakness is in its low winter output of eggs, but all the signs indicate that farm poultry will be more profitable in the future than in the past.

One of the effects of the War has been to stabilise commercial poultry farming for egg production. This branch of the industry has now assumed a firmer position, owing to the more general adoption of proper methods and to the enhanced prices which are obtained for produce. Great progress has been made and will most likely continue to be made, but there is yet much to learn. Many problems are unsolved. Results will largely depend upon a higher average production. The principal difficulty for those taking up the business at the present time arises from the high cost of equipment, and until prices of materials fall very considerably capital expenditure will be heavy. Domestic poultry, whether owned by residents in towns or country, have increased largely of late years. Small individually, in the aggregate this source of supply is very appreciable, and is capable of enormous extension. Economically, this aspect of the industry is one of the most promising.

The high prices obtainable for stock may be held to have considerably strengthened the position of breeding farms. Prices have increased by 200 to 400 per cent., and there is a considerable demand. Poultry breeding, which was always the best paying branch of the poultry industry, has during the last three years attained still greater importance. The day-old chick trade has also increased very largely, and more breeding farms and hatching stations are likely to be required as poultry keeping increases. It may also be mentioned that the importance of paying regard to utilitarian qualities in exhibition poultry is now recognised to a greater extent.

During recent years knowledge of the principles underlying poultry breeding and management has been acquired as the result of wider experience and more careful study of the problems involved. There is, however, still a comparative lack of knowledge, and in particular there is need for the extension and development of scientific experimental work, and inquiry into the causes and prevention of disease. The two main purposes of the promised National Poultry Institute should be (1) experimental work of the nature indicated; and (2) the training of instructors, who in turn will be able to teach farmers and managers of, or workers on, larger poultry farms advanced and more profitable methods. Efficient training and instruction among our rural population, both men and women, as assistants to farmers and others, is required.

UTILITY RABBIT KEEPING AT PUBLIC INSTITUTIONS.

IN 1912, as a result of the study of notes on rabbit keeping issued by the Board of Agriculture, the authorities at a hospital in the south-east of England decided to test the possibilities of rearing rabbits. It was felt that the large amount of waste food-stuff left over at the hospital would offer special facilities for the feeding of the rabbits, and that the undertaking would thus be a means of assisting in the general economy of the establishment, while, if the experiment proved a success, the lessons might serve to encourage similar Public Institutions in the country to take up work of a like nature. As the initial stock for the experiment, thirteen does and one buck were purchased. The following notes have been contributed by the Steward of the Public Institution referred to:—

During the first year the rabbits were all housed in hutches made at the Institution. With a view to effecting economies in expenditure on equipment, however, it was later decided to proceed as much as possible on outdoor methods, and an attempt was made to extend the rabbitry by means of a warren.

To this end a small gravel pit with a sloping run leading to a partially shaded plateau was utilised. The pit was sheltered on one side by a thatched "lean-to," and on the other by tree trunks and brambles. The rabbits placed in this area increased in numbers, and surplus stock were from time to time removed, but after some months they were attacked by disease and the experiment was discontinued.

Brooding and rearing have since been confined to the hutch system, ordinary hutches being used for breeding, and long, wire-bottomed ones for the rearing of young rabbits. The latter hutches have the disadvantage of being rather wasteful of straw, but this disadvantage is more than counterbalanced by the small amount of labour necessary to keep the hutch clean and the fact that the floor is always in a dry condition.

Value of Produce.—During the year ended 31st March, 1915, in spite of inexperience at the initial stages and the severe check received as a result of the outdoor experiments, 1,481 lb. of meat were produced for home consumption, and 1,715 lb. in 1916. Last year (1919) the rabbits reared produced over 4,000 lb. of meat.

The cost of feeding during the years ended 31st March, 1919, and 31st March, 1920, was £42 and £88, respectively, and the

value of the returns in the form of meat and other produce was estimated as £83 and £187. A portion of these amounts was received from the sale of skins.

The above profits were made from cross-bred Flemish-Belgians and pure-bred Belgians. They would probably have been much larger had the best fur-producing breeds been kept from the start, as the pelts from these are now commanding a high price in the market.

Breeds.—From the writer's experience larger types of rabbit (Flemish Giant, or Flemish-Belgian crossbred) are not so profitable as some of the newer breeds. At present, on account of the high prices obtainable for pelts, the production of a larger type of Silver Grey and the breeding of Havanas and Beverens has been adopted in preference to utility rabbits. Of these the Silver Grey and Havanas mature earliest.

If cross-bred does are used it is desirable to mate with small-boned pobby bucks, such as Silvers, Dutch and Havanas, as the progeny of these crosses are preferable for fattening and produce a minimum of offal. Of the pure-bred crosses, apart from the question of pelt, the Belgian Hare doe crossed with a Silver Brown buck is, in the opinion of most judges, the best cross.

Feeding.—A medium-sized doe (7 lb.) with a litter of 7 a fortnight old should do well during the winter months on a daily ration of:—

6 oz. Bran.
1 „ Fish Meal.
8 „ Green Food.
1 „ Hay.

If it is desired during the winter to force the youngsters for killing at 16 weeks old, single fattening pens for housing are preferable.

For the medium-boned varieties (Beveren) a suitable daily ration is:—

1 oz. Bran.
 $\frac{1}{2}$ „ Fish Meal.
8 „ Green Food.
 $\frac{1}{2}$ „ Hay.

A breeding doe during the winter will thrive on a daily ration of:—

3 oz. Bran.
 $\frac{1}{2}$ „ Fish Meal.
1 „ Hay and a fairly plentiful supply of green food.

Well-grown 8-week youngsters will thrive from March to August on *ad lib.* supplies of succulent green food, with a minimum of $1\frac{1}{2}$ lb., supplemented by $1\frac{1}{2}$ oz. of hay. Water should

always be placed in the hutches, and grasses should be gathered from open sunny spots.

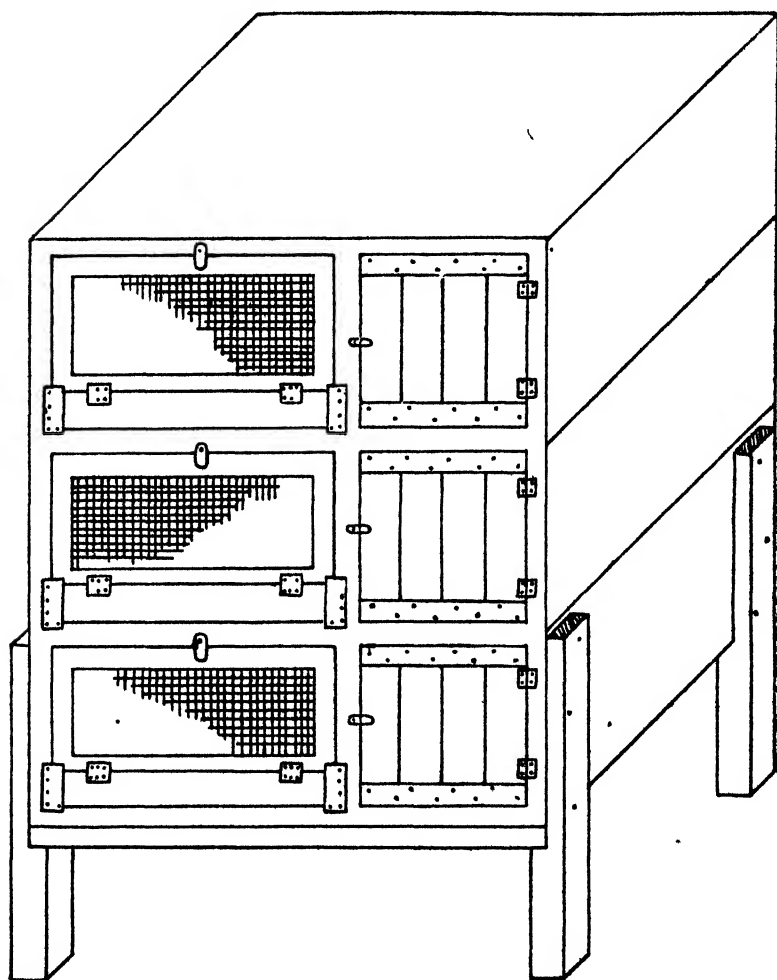


FIG. 1.

Hutches.—Bacon boxes are easily converted into hutches, and are at present obtainable at prices ranging from 2s. 6d. to 8s. 6d. each. Wire and felt are additional items of expenditure.

The outlay may be cheapened and space economised by making single hutches in sets of three (Fig. 1). It is found better to have a breeding section in each hutch, instead of loose nest boxes. Fattening pens can be made from sugar boxes and fixed in tiers to suit the space available. The writer has found that a set of nine compartments (Fig. 2) is the most convenient for handling.

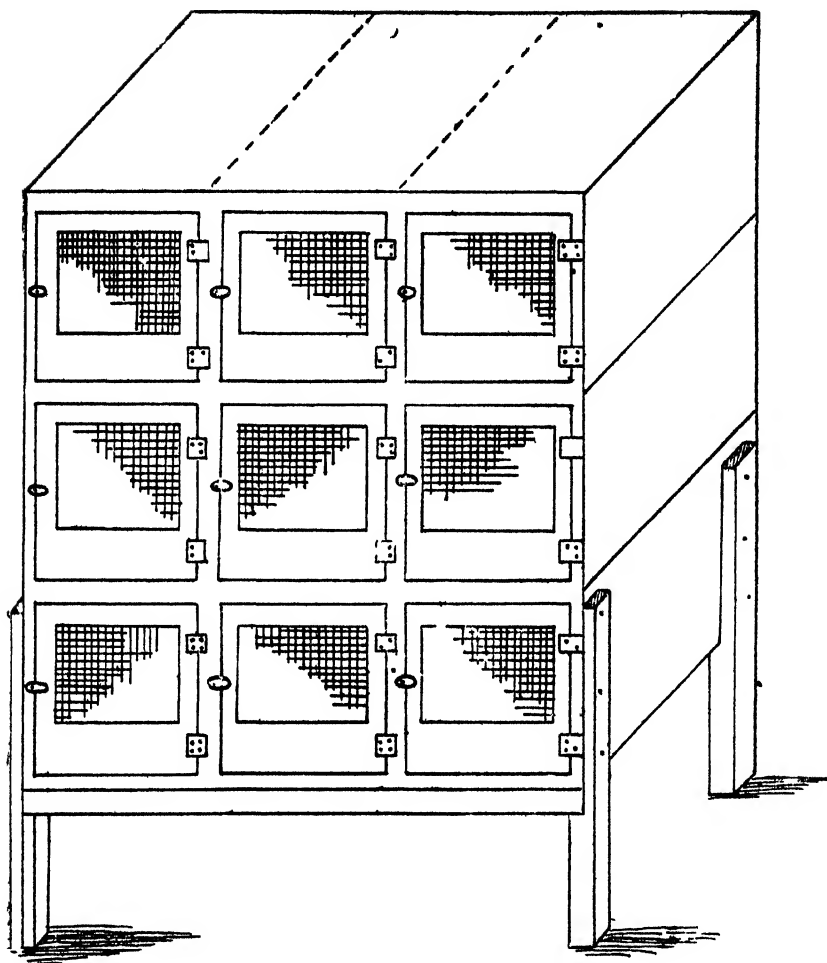


FIG. 2

Some protection is necessary against rain or snow during the winter months, and condemned waterproof sheeting has been used for this purpose. The only objection to such sheeting is that it is untidy. Shutter boards with ventilation holes look better, but are more difficult to control. The insides of all the butches should be periodically limewashed.

Feeding troughs have been made from old boxes at the Institution, but as the rabbits usually nibble these away very quickly, flanged earthenware pots are now used. These pots cost less than 6d. each.

Breeding.—The writer has found it advisable to fix a card on each hutch to record the date that the doe is due to litter and

particulars as to productiveness and mothering value. Fat does are seldom of value for breeding. All does should be examined before mating, for vent disease. The best does for breeding purposes in the winter are those retained from spring litters of the same year. Does must be taken to the hutch of the buck; not *vice versa*. After one satisfactory mating the doe should immediately be taken back to her hutch. Nothing is gained by a second mating. Only healthy does should be used for breeding, and the youngsters from the litter which make the most rapid growth should be retained for the purpose.

The writer would advise beginners to purchase at the commencement only a few does and a really good buck of the breed decided upon. In the case of a Public Institution it is possible that one or more members of the staff may possess a knowledge of rabbit keeping, in which case he should instruct those who would have the care of the stock in the principles of the subject.

In conclusion, it may be stated that the addition of rabbits to the utility live stock kept on the premises in question has provided not only open-air recreation and interesting work for a number of the inmates, but also a ready supply of meat, which has given a welcome variety to the menus of both staff and patients. Bearing in mind the urgent necessity for increasing our home production of food, the huge quantities of rabbits annually imported, and the fur shortage, and having regard also to the exceptional facilities which a Public Institution possesses for the profitable rearing of rabbits, the keeping of such live stock is well deserving of careful consideration, and may be urged upon all those concerned. Apart from the advantages in the way of food, the financial returns from the undertaking should mean a corresponding reduction in the burden of the local rates, and the idea might properly commend itself to local authorities on these grounds.

BUILDINGS FOR SMALL HOLDERS: EXPERIMENTS IN ADAPTATION.

CAPTAIN S. DOUGLAS MEADOWS.

IN these days of soaring prices, when established pre-war ideas as to building costs have become obsolete, it behoves everyone interested in the equipment of the new small holdings which are being created under the Government's Scheme of Land Settlement for ex-Service men to test every means which might suggest itself for carrying out building operations on the most economic lines, consistent with efficiency. Any existing buildings which by alteration, and possibly addition, can be adapted to the purpose in view should be utilised to the fullest possible extent.

In the case of farm buildings, it is particularly necessary that the fullest advantage should be taken of any existing buildings which can serve any useful purpose in a new scheme of equipment. The isolated position of most farms, and the absence of good roads to them, make haulage of building materials a considerable item of cost, and the adaptation of these existing buildings is a far cheaper proposition than the provision of new equipment would be.

Old farm buildings are generally of the rambling type, and do not appear to have been designed on any definite principle. They are often spread over a wide area of land that could be more profitably utilised in other ways, and they are rarely built square in themselves or with each other. A good deal of space is wasted in this manner which could be utilised to some purpose by a little thought and ingenuity in the adaptation of the buildings. Waste space, cumbersome and rambling buildings, although they may be picturesque in appearance, are uneconomic in the pressing needs of up-to-date farming. Buildings must be judged only from the point of view of their efficiency, and beauty in artistic design should be made to conform to this consideration.

PRESENT ARRANGEMENT OF
FARM BUILDINGS.

NOT TO SCALE.

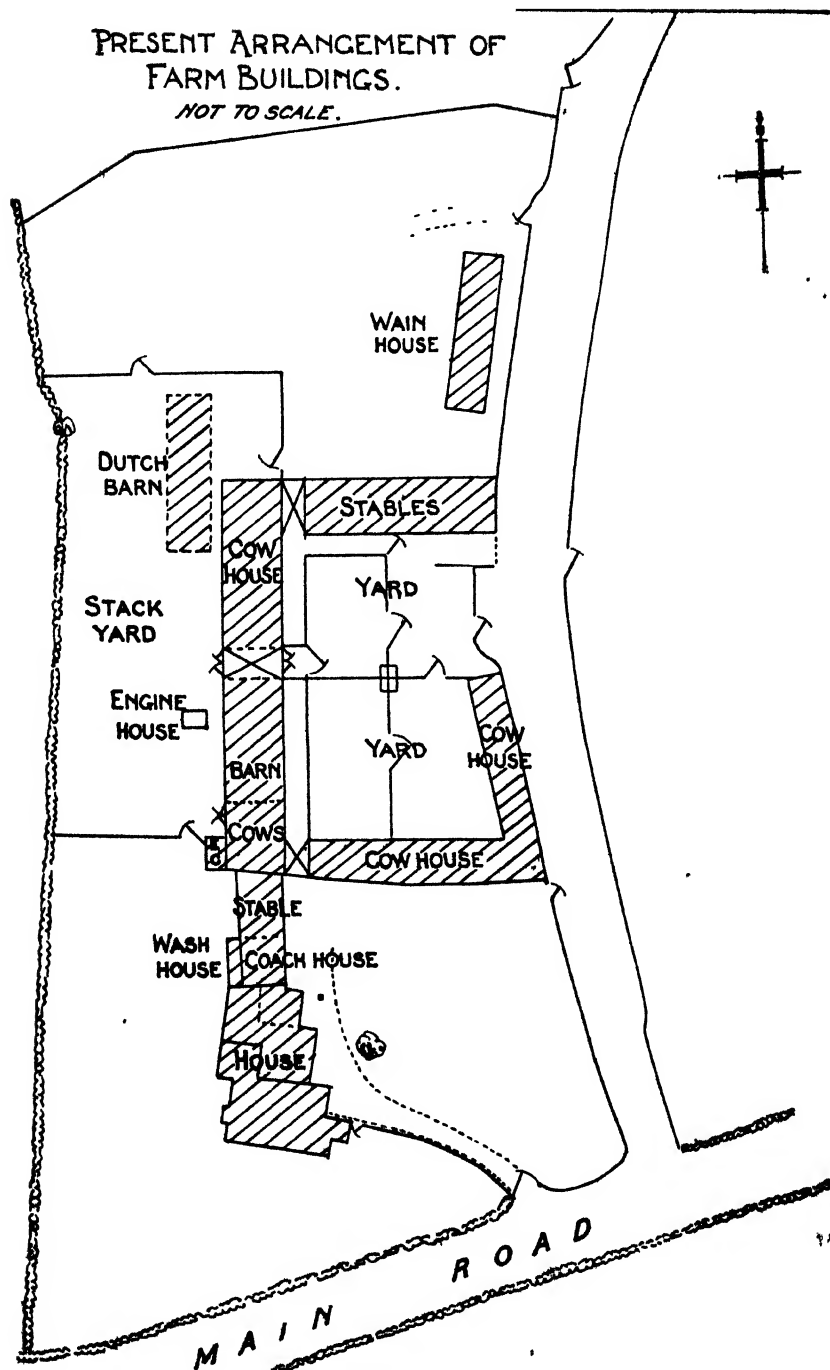


FIG 1.

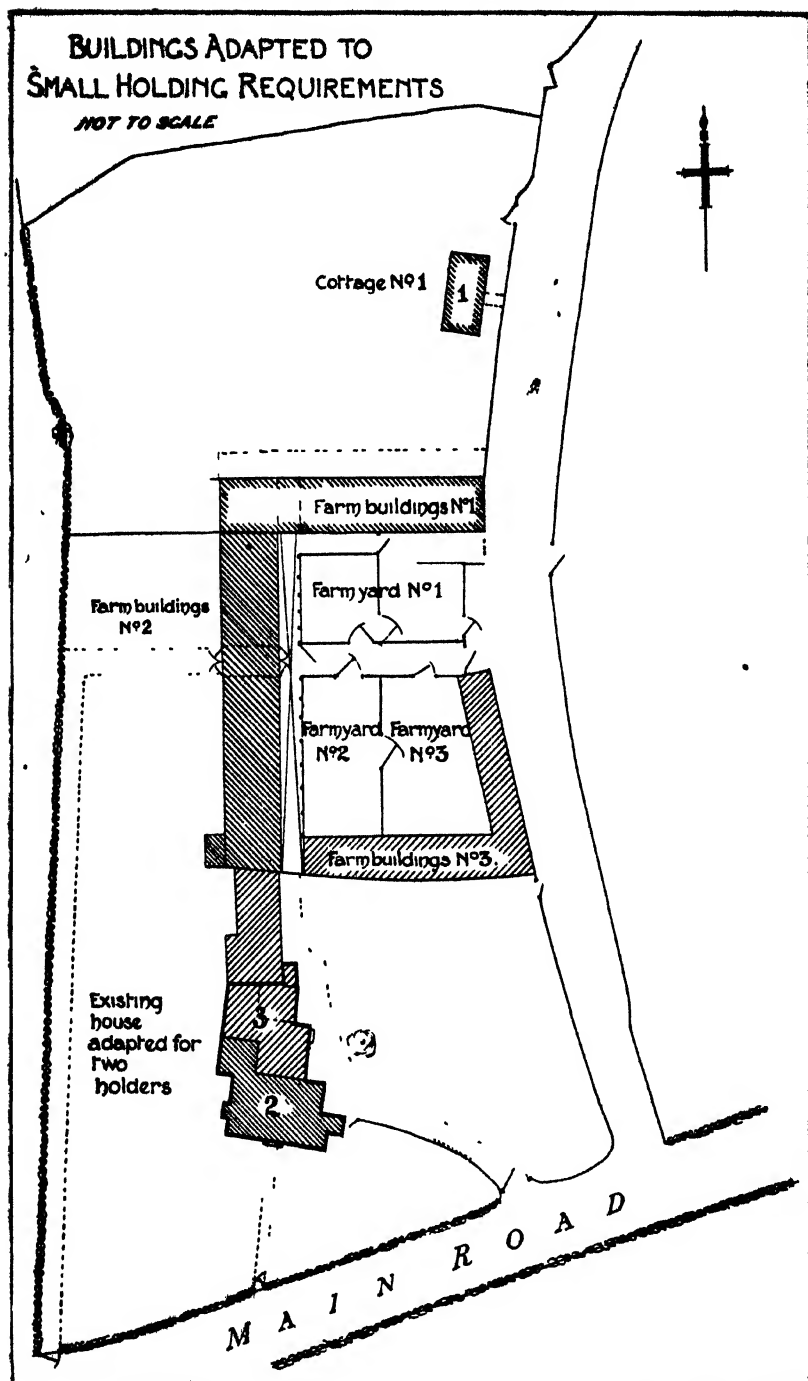


FIG. 2.

On a great many farms, therefore, certain unnecessary and inefficient buildings may be dispensed with to provide room and material for more up-to-date accommodation, making a really useful farmstead. The materials thus provided will be to hand on the site, no carting will be necessary, and the old material not used in the actual adaptation may be utilised for road-making and concrete work.

Road-making is of importance, and a good approach is becoming increasingly necessary with the extended use of mechanical vehicles.

Each case of adaptation must, of course, be dealt with on its merits. It will be necessary, first of all, to know what accommodation is required, and how it can best be provided. A survey of the buildings is necessary, so that the whole scheme may be viewed in its true perspective, and in proper relation to its surroundings. After the general scheme has been settled, details may be decided on the site. In this connection it may be well to advise against considering details before the general scheme has been decided upon. The accommodation for cows, stock, horses, pigs, and the various other animals on the farm should be arranged for, and the position marked in the general scheme; details as to position of doors, windows, &c., can be considered after the main lay-out is settled.

Old farm buildings frequently have many different floor levels, with consequent steps and angles. Generally, on the ground floor plan this can be remedied, and the floor made up to the same level throughout. This alteration cannot be so easily carried out on the first floor, however, especially in half-timbered buildings. It will make for convenience if all floors can be made level. It is advisable, also, to square up a plan, if possible, eliminating dirty and dark corners, and opening up covered-in spaces.

By dividing an existing farm into two or three holdings, it is often possible to provide more accommodation at considerably less expense than if entirely new work were undertaken. The accompanying illustrations of a farmstead on the Ministry's estate at Bosbury, Herefordshire, afford an example of how existing buildings have been altered, with comparatively little expense, to meet modern requirements. The farm buildings have been divided into three, the house into two. A new cottage will subsequently be provided for the third set of farm buildings. The farm did not lend itself particularly well to division, but with some ingenuity it has been possible to equip two 50-acre

holdings, and a third holding may ultimately come into the scheme.

The general lay-out of the farmstead is shown in Fig. 1, and its proposed adaptation and sub-division in Fig. 2. A common road through the farmyard makes separate entrance to each of the yards possible (compare Figs. 1 and 2). Owing to the difference of level it is difficult to depart very drastically from the old means of approach to the farm buildings, but these have been improved and made good.

The house, a red brick Georgian farm house with remains of an older building, has been divided into accommodation for two families. The third cottage will be built later. As a result of the adaptation each house will contain 4 bedrooms, living room, parlour, wash-house and dairy, with a third of the farm buildings.

Fig. 3 shows a plan of the ground floor (of the house) before adaptation, and Fig. 5 the manner in which the rearrangement and alteration of the various rooms have been carried out.

Fig. 4 shows the first floor before adaptation. It will be seen that a large amount of useful space is wasted in landings and corridors. By rearranging the northern staircase, access is obtained to the bedrooms without passing through the living room of house No. 3, and by removing the corridor, a small bedroom in house No. 3 is enlarged to a useful size, and a box-room in house No. 2 is converted into a bedroom (compare Figs. 4, 5 and 6).

Fig. 7 shows the progress of the work of alteration. The cost of this adaptation will be about £500, the work on farm buildings will cost another £500, and the new cottage £1,000. At a cost of £2,000, therefore, three holdings will have been equipped, and a good deal more accommodation provided for the money expended than would have been possible if entirely new buildings had been erected.

Wherever possible, an absolute division of the holdings has been aimed at. Small holdings should not overlap, or small holders trespass upon the land of their neighbours. This point should at all times be taken into account, in the interests of the harmonious working of the settlement. In the case illustrated, entirely separate approaches have been provided to each set of farm buildings, and each farmstead stands on its own land.

On some farmsteads a common dairy may be provided when small holders propose working together on a co-operative system. This has not been done in the case here mentioned, as each of the small holders is farming differently.

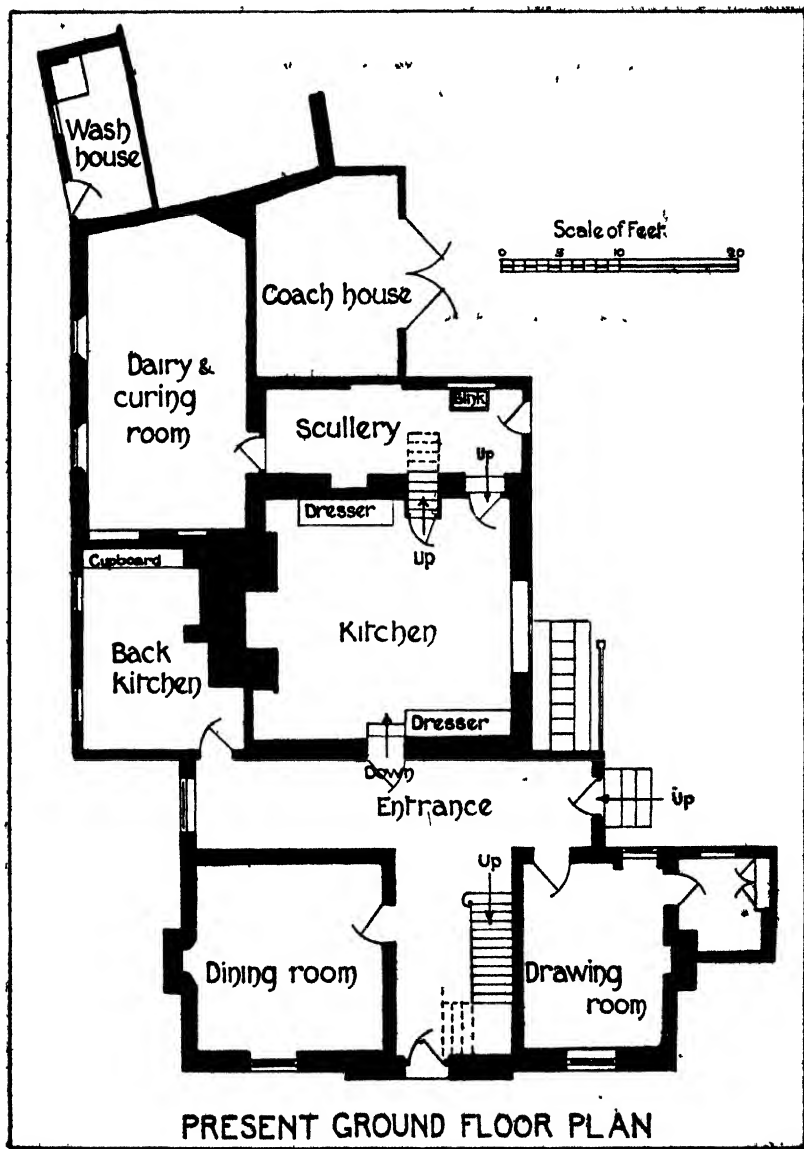


FIG. 8.

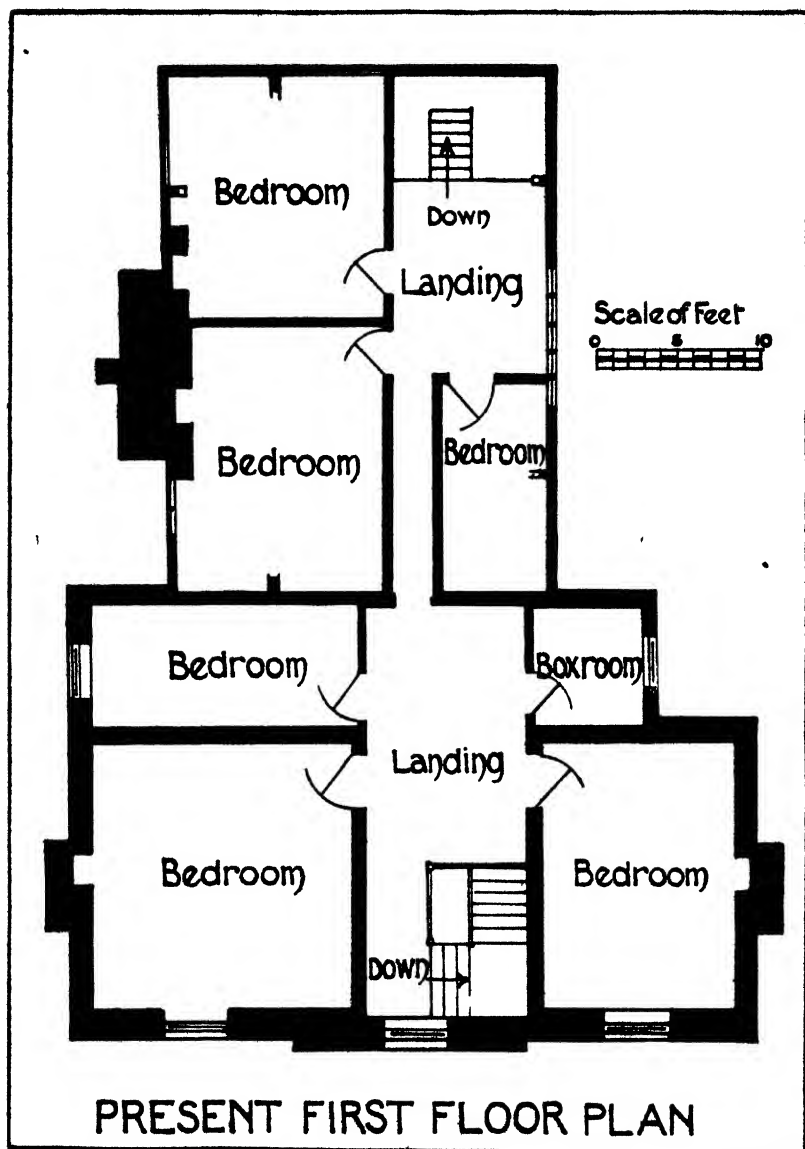


FIG. 4.

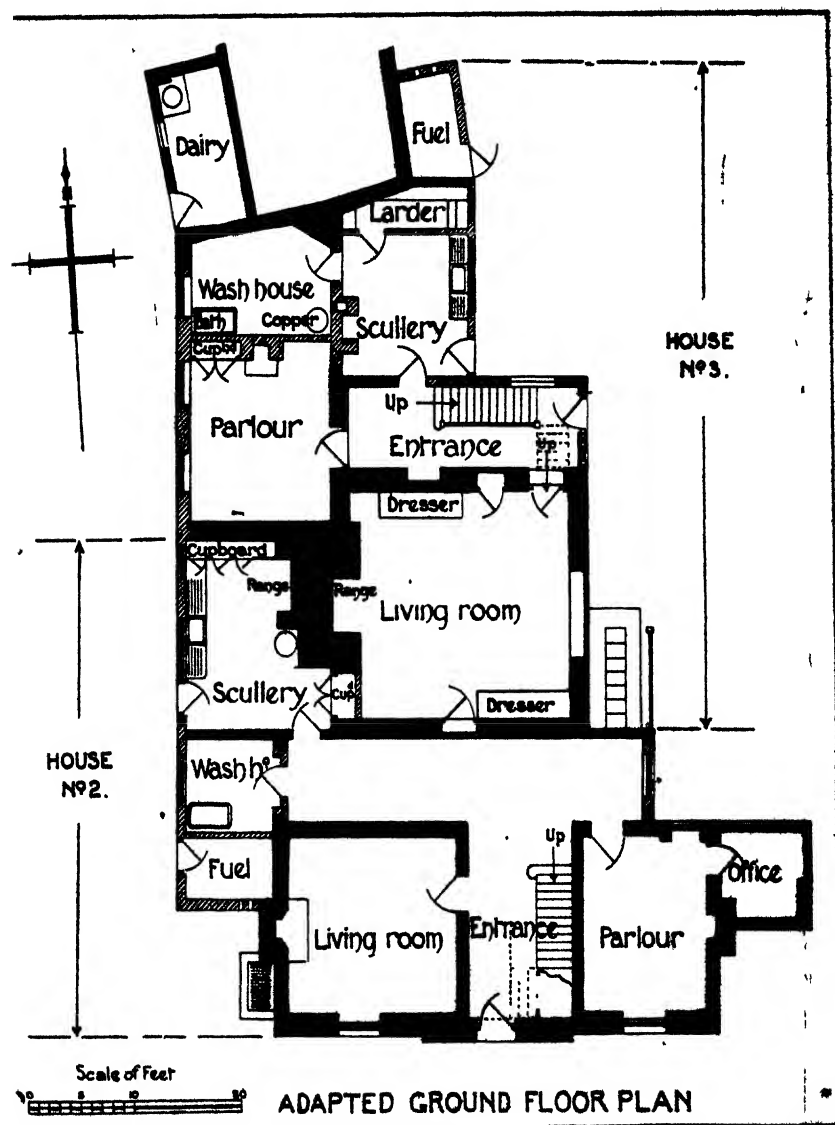


FIG. 8.

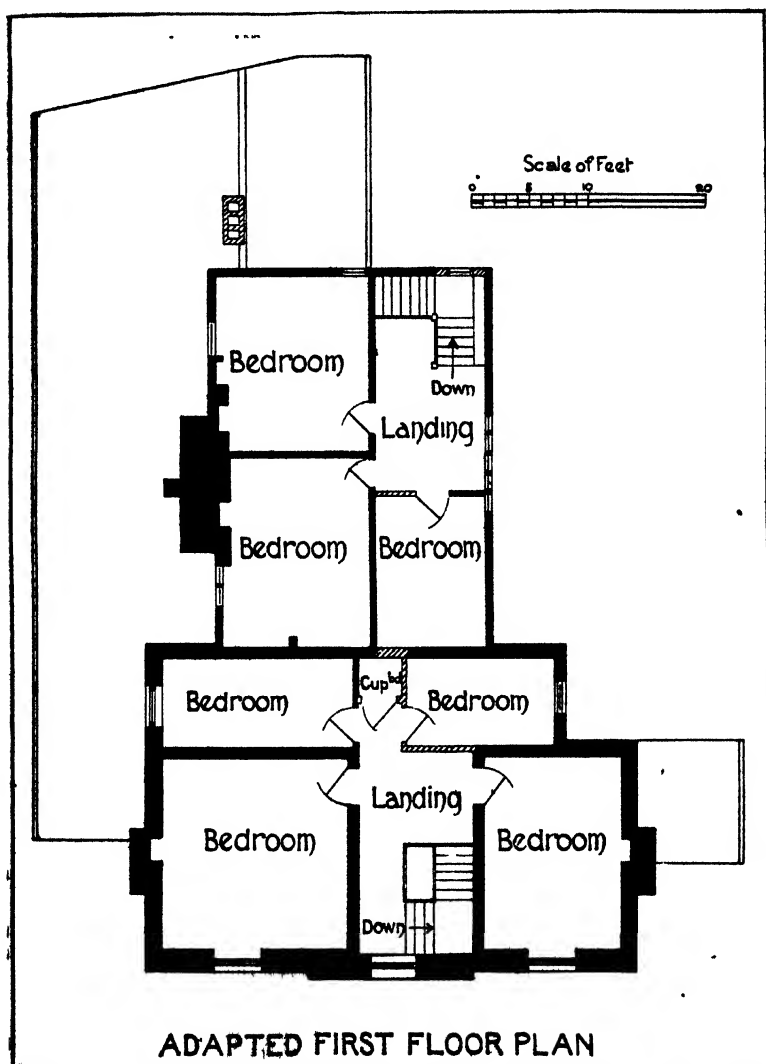


FIG. 6.



FIG. 7.—Farm House at Bosbury showing progress in the work of adaptation

At Bosbury the existing buildings were all utilised, and very little pulling down was done. All old material was re-used in some way or other, and the scheme has proved most economical.

The work of adaptation was carried out by direct labour by men of the estate, with some assistance from outside bricklayers, carpenters, plasterers, and other workmen. All the roads were constructed with unskilled labour under the supervision of an experienced roadman. A quarry was opened on the site, and supplied material for the roads and certain building work. Very little excavating was done for the roads, the virgin soil only being removed to a depth of some 6 inches. The cost of road-making was 10s. per yard, which included quarrying of stone and surfacing with clinker. The clinker was obtained free from the Malvern Electric Works, but, of course, had to be hauled to the site. The roads were 9 feet wide and about 9 inches deep.

It is very essential that there should be an adequate water supply which can be relied upon during the dry summer months. To this end it is desirable to obtain the advice of an expert water diviner and engineer. This has been done on the estate in question, and a central supply from a boring is being installed. Drainage is very closely allied with water supply. In this connection existing drains should be utilised as far as possible, but if there is any possibility of their contaminating the water supply, a new system should be put down. Farm sewage is an essential farming commodity, and should be conserved, and not diluted by mixture with the rain water or the house sewage. All three should be kept separate, as they each have their different uses. Rain water should be collected wherever possible for domestic purposes, and not allowed to run to waste in the farm drains, so diluting the liquid manure. House drainage, consisting of sink and bath waste, with, perhaps, a water-closet, needs separate treatment, and should not be connected with either the farm system or the rain water drains. The collection of the house drainage into a cesspool or surface irrigation system is usually not difficult, and is a most desirable arrangement. No elaboration of manholes or inspection chambers will be necessary; all that is required is a simple pipe line to a cesspool some 50 yards away from the house. In the case in question, old drains were utilised wherever possible, and a separate system was introduced for the house discharge. A rain-water butt or tank near the scullery door, with an overflow to the sink gully, is most useful, and helps to conserve the water supply.

These three 50-acre holdings will be equipped at a cost of about £3,000, or £1,000 each, including roads, water supply and fencing, and will be a very considerable saving over entirely new equipment.

The foregoing applies more or less to most small holding adaptations, and the secret of success lies undoubtedly in a careful study and survey of existing buildings. In many cases it is impossible to grasp the situation properly without getting the whole of the existing property carefully plotted to scale. It will then be possible to consider many suggestions before finally deciding upon the best means of carrying out the adaptation. In this way, therefore, indifferent buildings may be converted to modern requirements and serve a most useful purpose in the Land Settlement Scheme.

THE SCORCHING OF FOLIAGE BY SEA-WINDS.

L. A. BOODLE.

NEAR the coast, injuries to the leaves of trees and shrubs are often observable after a gale from the sea, some of the leaves becoming brown and withered as though scorched. Similar damage is sometimes caused several miles inland in exposed situations. In both cases this effect of the gale is often attributed to the injurious action of salt spray (or particles of salt derived from spray) carried by the wind and deposited on the leaves.

Evidence of the transport of salt by a strong sea-wind is often supplied by the appearance of a damp salty deposit on the seaward windows of houses standing with little protection a mile or two from the coast, while, in the case of a violent gale, an appreciable amount of salt may be carried to a great distance. As an example of the latter occurrence one may refer to observations recorded on the occasion of a great storm which visited Liverpool and various parts of the Kingdom in January, 1839. Ackroyd* states that during this gale "trees and hedges in many places, *e g*, Huddersfield and Longton, appeared to be covered with a white frost, which on analysis proved to be a briny deposit which the wind had brought from the Irish Sea."

The question, however, whether or to what extent salt is responsible for the damage to foliage by sea-winds, is one that is not readily answered. Various writers have discussed this subject, together with the associated one of the cause of the characteristic form presented by trees and woods in proximity to the sea. In the case of isolated trees (which are stunted in proportion to the degree of exposure) the shape is asymmetric, the crown being more developed on the side away from the sea, while the side facing the sea shows numerous dead twigs or branches, testifying to repeated injuries on that side† The configuration of woods adjoining the coast gives similar evidence of injury by winds from the sea, in the dwarfing of the trees nearest the coast, and the gradual increase in height of the trees towards the landward side, where the wood itself gives progres-

* Ackroyd, *Chem. News*, Vol. 84 (1901), p. 56, as quoted by Blackledge, *Ann. Bot.*, Vol. 27, p. 169.

† The twigs in some cases may have been killed by frost in winter, as a consequence of the wood having been insufficiently "ripened" owing to the early destruction of the leaves (*Grübner, Lehrb. d. allgem. Pflanzengeographie*, 1910, p. 225).

sively increasing protection from sea winds. The clean-cut surface of the crowns, forming a uniform upward slope, also shows the connection between shelter and growth.

Some authors who have dealt with the subject explain the injuries as due to the direct action of salt, while others attribute them primarily to the drying action of the wind, or largely to mechanical injuries brought about by storms. A short consideration of these views is given below, with some references to the literature.

Focke,* after referring to the damage to trees, in certain coast-regions of Germany, caused by winds, and especially by storms from the north-west, remarks that, where there is sufficient shelter towards the north-west, trees succeed quite well, even on the islands, but that they never grow higher than the protecting dunes or houses. He adds:—"The action of the sea-winds probably depends on the salt-dust which they carry with them."

Statements by other writers who hold the same view are mostly of a similar nature, injury by salt being inferred from comparative observations on the effect of exposure and of protection towards the sea. For instance, Anderlind,† after referring to cases in which pine trees near the coast showed browning or loss of the leaves of exposed branches, attributes this injury, and the damage shown by Dicotyledonous trees in the same situation, to the action of salt spray. Data of this kind, however, are quite inadequate as a basis for the solution of the problem, because the side facing the sea, and therefore exposed to salt, is ordinarily the side on which the full force of the wind reaches the trees, the velocity of the lower strata of air during a wind from the sea not having been reduced by conflict with various obstacles, as is the case with wind which has blown over any long stretch of land‡ other than a flat waste.

Injury by the Wind.—Thus the dependence of injury on exposure to sea-winds does not preclude the possibility that the phenomenon might be due entirely or largely to the action of the wind itself. This possibility is emphasised by the fact that the special forms characteristic of trees which have been repeatedly injured on one side are to be seen in various types of exposed

* Focke, *Unters über die Vegetation des nordwestdeutschen Tieflands*, Abh. naturwiss. Verein., Bremen, Vol. 2, p. 405 (1871)

† Anderlind, *Die Wirkung des Salzgehaltes der Luft auf die Strandkiefer*, H.-A. Forstl.-naturwiss. Zeitschr., 1897, ref. in Just, *Jahresbericht*, 1898, II. p. 312; see also Buchsbaum, *Bremen Abh. naturw. Verein.*, Vol. 3, (1873), p. 525; Evans, *Gard. Chron.*, 3 Ser., Vol. 59, p. 119.

‡ On a small island, where wind and salt may come from any quarter, the chief injuries show the direction of the prevailing winds or most frequent storms.

localities far inland, examples being found according to Warming* in oak-scrub in Central Jutland or in the centre of Switzerland." Statements of this kind, of course, leave some doubt as to the precise nature of the injuries which have ultimately led to the one-sided growth. There are, however, data which show that damage to leaves by wind in the absence of salt can be quite similar to that effected by sea-winds. An instance is given by a record of the scorching of leaves of trees and shrubs by a wind at Burlington, Vermont, U.S.A., in July, 1900.† The wind was described as unusually heavy and dry, and, being from the west, there was no question of the effect being due to salt. Leaves were killed on the west side of the trees, especially the outer trees along the western margin of the woodlands, and also on the same side of different shrubs, the scorching usually beginning at the apex and margin of the leaf.

Hansen,‡ who made observations on the East Friesian Islands, discusses the question of the cause of the injuries to leaves, noticed by him, at considerable length, and concludes that wind is the all-important factor responsible for the damage. The explanation of the phenomenon given by him§ and other writers is that, owing to the drying action of the wind, water is so quickly removed by evaporation from small portions of leaf-tissue that there is no time for conduction of water from the neighbouring cells, and that the tissue concerned consequently dries up and becomes brown. Hansen observed that the drying of the leaves began at the apex and margin, and that leaves were often completely killed, not by gales, but by long-continued winds of ordinary strength, the process of drying being a slow one, and progressing gradually from the margin inwards. The same type of withering, beginning at the apex and margin,|| may often be seen, as a result of exposure to strong winds, in different inland localities (away from exposure to salt), and is indeed a common effect of prolonged insufficiency of water in the leaves of trees, shrubs and herbs,¶ and may also be brought about experimen-

* Warming *Oecology of Plants*, Eng. ed., 1909. p. 37.

† 13th Ann. Rept., Vermont Agric. Exp. Sta., 1900, pub. 1901, pp. 281-2.

‡ Hansen, *Die Vegetation der Ostfriesischen Inseln*, Darmstadt, 1901. This work contains numerous references to literature and much criticism. Kroll, *Wind und Pflanzenwelt*, Beih. Bot. Centralbl., Vol. 30 (1913), 1, p. 125.

§ Hansen, *loc. cit.*, p. 32.

|| Then sometimes in patches between the larger veins, the parts first affected being those to which water can be less rapidly supplied.

¶ Yapp, *Spiraea Ulmaria*, L. and its Bearing on the Problem of Xeromorphy in Marsh Plants, *Ann. Bot.*, Vol. 26, p. 815 (1912); Hansen, *Flora*, Vol. 93, p. 32 (1904). See also Schröder, *Ueber den Verlauf des Welkens*, Diss. Göttingen, 1909, ref. Bot. Centralbl., Vol. 114, p. 353 (1910).

tally, as was demonstrated by Hansen, by means of a "wind-machine."*

It is thus clear that injury to foliage, of the same type as that seen near the coast, can be caused by wind in the absence of salt. As, moreover, unprotected inland plains may exhibit damage to trees comparable in degree to that observed near the coast, and showing clear indications of the direction of prevailing winds, one may say that general observations, while not disproving the occasional occurrence of injuries by salt spray, suggest that the action of wind alone would be sufficient to account for a great part, at any rate, of the damage caused by sea-winds.

A case of the scorching of foliage by a gale from the sea on the coast of Chili is described by Ochsenius.† In a densely wooded coast-region, sharply limited tracts of forest showed dried-up leaves and twigs, in marked contrast to the fresh green foliage of the adjoining stretches of forest. The phenomenon, which is stated not to occur oftener than once in about ten years, is attributed by Ochsenius to the action of an unusually dry south-west wind, the sharp demarcation of the scorched areas being explained as due to the configuration of the land affecting the force of the wind. The question of injury by salt in this particular instance is dismissed by Ochsenius, who argues that, on account of the frequency of storms in the locality, no vegetation could have thrived on the temporarily scorched areas if wind-borne salt were the cause of the damage.

General observations on the effect of partial protection from sea-winds are, of course, not decisive as to the precise cause of injuries due to exposure. Hansen‡ refers to the relative success of trees planted behind screens of lattice and brushwood in Borkum and Norderney, and argues that, if salt were concerned as an injurious factor, the screen should have no effect, because, not being impervious to wind, though breaking the force of it, it would allow salt to pass through to the trees. Without information as to the amount of salt which in such cases actually reaches a partially sheltered position, however, no definite deduction can be made.

Borggreve§ attributes the injurious influence of wind on the growth of woody plants on the Baltic coasts of Germany chiefly

* Hansen, *Flora*, Vol. 93, p. 38

† *Wirkungen der Stürme auf Pflanzen*, Abh. naturwiss. Verein., Bremen, Vol. 12, 1893, p. 484.

‡ Hansen, *Veg. ostfries. Inseln*, p. 34

§ Borggreve, *Einwirkung d. Sturmes auf d. Baumveg.*, Bremen Abh. naturw. Verein., Vol. 3 (1873), p. 251, Gerhardt, *Handbuch d. deutsch. Dünenbaues*, 1900, p. 428.

to mechanical injuries.* Damage of this kind, of course, occurs during gales, but, in the region referred to, Hansen's observations† indicate that the drying action of storms and of long-continued winds causes injury to a much greater extent, and the same relation is probably of general application. Borggreve refers to the question of injury by salt, and states that storms from the sea on the Baltic coast as a rule only carry small quantities of salt. He also contends that trees protected by buildings, embankments, hedges, &c., would be equally or more exposed to salt than those standing without protection, because heavy particles suspended in the air would tend to be deposited where the air is less vigorously moved. The argument, however, is a superficial one, and is unsupported by direct observation of the distribution of salt under the conditions referred to. In comparing an exposed and a partially protected situation, one would probably be much less concerned with the settling down of salt particles owing to their weight than with the relative quantities of salt brought into contact with foliage by the wind in a given time, the salt being frequently either contained in spray, or brought in the form of damp particles which would adhere to anything they touch, while the amount of salt arriving in a given time would be decreased wherever the velocity of the wind is reduced. On the other hand it may be supposed that, in the special case of a very heavy spray being carried by a wind, the unprotected external foliage of trees may become so wet that the salt water, dripping on or blown on to the leaves of the interior of the crown, may eventually expose many of these to about the same amount of salt as that remaining on the exposed leaves. In the absence of definite data, however, it is inadvisable to base any argument on this supposition.

Before considering the manner in which salt might occasionally be a contributory cause to damage, some further remarks on the action of wind should be made. The effect of wind in causing loss of moisture from foliage by transpiration will depend on both the degree of dryness and the velocity of the wind. Dry air naturally favours transpiration, and wind in most cases has the same effect. In still air the water-vapour transpired by a leaf accumulates to some extent in its vicinity, thus checking transpiration, while during a wind the vapour-laden air is continually removed, so that the leaf transpires actually into drier

* Such as bruising and breaking of branches and leaves. Mechanical injuries may perhaps be caused by wind-blown sand in certain localities (see Gerhardt, *loc. cit.*), but probably chiefly to young leaves of shrubs.

† Hansen, *Veg. ostfræes. Inseln*, p. 86.

air. Wiesner* found that in certain cases transpiration in a wind may reach twenty times its value in still air, and that the different behaviour of different plants depends largely on the partial or complete closing of the stomata during wind† and on the amount of cuticular transpiration. Though transpiration is usually increased by wind, it may be reduced in certain cases, as was found in *Saxifraga sarmentosa*, in which intercellular transpiration was stopped by the rapid closing of the stomata, and the cuticular transpiration was small. Young leaves, having a relatively high cuticular transpiration, would show a large increase in the amount of water lost through the cuticle during wind, and this increase would often considerably more than compensate for the reduction or cessation of stomatal transpiration by the partial or complete closing of the stomata. Young leaves may therefore be expected to be specially liable to wind-withering.

Injury by wind, being due to uncompensated loss of water by the leaves, will depend on the combination of a number of factors, viz., those favouring transpiration and those diminishing the supply of water to the leaves. Among the latter would be dryness and coldness of soil, both checking absorption by the roots.‡ It is easy to understand, therefore, that the effect of a storm may depend to some extent on the character of the soil, on the season of the year, and on the nature of the weather preceding the storm.§

In this connection it may be pointed out that wind-borne salt might in some cases be a factor indirectly favouring injury to the foliage by wind. Supposing a considerable amount of salt spray to soak into the soil during a gale, the absorptive power of such roots as were reached by the salt would be temporarily affected,|| and the supply of water to the leaves would be interfered with in consequence.

* Wiesner. *Sitzb. Wien. Akad.*, Vol. 96 (1887), ref. Just, Jahresbericht, Vol. 16 (1887). I, p. 216.

† This does not occur in all plants. The stomata of *Hydrangea hortensis* were found by Wiesner to remain wide open even during a strong wind, greatly increased transpiration being the result.

‡ Kihlman, *Pflanzenbiol. Studien aus Russisch Lappland*, *Acta Soc. Fauna et Flora Fennica*, Vol. 6. No. 8 (1890), p. 88; Molisch, *Unters. über das Erfrieren der Pflanzen*, Jena, 1897.

§ *Vermont Agr. Exp. Stn.*, loc. cit.

|| The roots after a time would in most cases resume normal absorption, as they would show a certain amount of adjustment of osmotic pressure. See Schimper, *Die indomalayische Strandflora*, 1891, p. 22. For an extreme case of the phenomenon observed in the roots of certain halophytes, compare Hill, *New Phytologist*, Vol. 7, p. 133, and Vol. 8, p. 103.

Direct Injury by Salt.—The question of direct injury to leaves by salt may now be considered. The leaves of most land plants, such as can be wetted, are slightly permeable to water with dissolved salts.* Experiments were made by Lewis† on the effect produced by immersing leaves of lilac, holly, arum and other plants in sea-water or in salt water containing about the same strength of sodium chloride. After immersion for 12 or 27 hours, all the leaves showed an increase in salt-content and a higher osmotic pressure of the cell-sap. In arum, lilac and *Cumellia* the first effect of immersion was loss of weight, indicating extraction of water from the leaf, but after three to six hours a progressive increase in weight began, while in holly and *Cavendishia* the increase began at once. Leaves of lilac and arum showed a considerable wilting effect when sprayed with sea-water, thus showing that water may be extracted from the leaf in this way also.

Before immersion of the leaves, the leaf-cells of all the plants became plasmolysed when sections were placed in sea-water (i.e., the protoplasm of the cells became contracted), but in most cases a stronger solution than sea-water was required to induce plasmolysis of the cells in sections cut from leaves which had been immersed for 12 to 27 hours, adaptability in the osmotic pressure of the cells being thus shown. It is concluded that the plasmolysis of cells and the wilting of leaves induced in certain plants by the presence of salt spray on the leaves would, at any rate in many cases, be a temporary effect if a supply of water were available for the regaining of turgescence.

In all cases the cells of the leaves were found to be living at the end of the experiments, hence one may say that no evidence was obtained that the amount of salt taken up by the leaves in these experiments would have any toxic action.

In the case of the foliage of trees exposed to salt spray, a certain amount of salt would at times pass into the leaves,‡ but whether a toxic effect would be produced§ in any case, unless excessive loss of water by transpiration should also occur, is

* Pfeffer, *Physiology of Plants*, Eng. ed., Vol. 1, p. 160; Dandeno, *Trans. Canad. Inst.*, Vol. 7, part 2; Boodie, *New Phytologist*, Vol. 3 (1904), p. 39.

† Lewis, On induced Variations in the Osmotic Pressure and Sodium Chloride Content of the Leaves of Non-halophytes. *New Phytologist*, Vol. 11 (1912), p. 255.

‡ Blackledge, *Variations in the NaCl-content of non-halophytes*, Ann. Bot., Vol. 27 (1913), p. 168. The observations in this paper are perhaps open to the objection that a comparison of the proportion of salt in the soil in different localities may give little or no indication of the relative amounts of salt which have soaked into the soil from time to time.

§ The data given by Coupin (*Rev. Générale de Bot.*, Vol. 10, 1898, p. 117) as to the strength of salt solution producing a toxic effect when supplied to the roots are of no service for the present question.

doubtful. Assuming a case in which wind causes severe wilting of the leaves, the cell-sap will become concentrated, and may eventually reach a stage at which the concentration of the salts dissolved in the cell-sap will be sufficient to cause "salting out" of proteids, thus injuring or killing the protoplasm.* This stage would be reached earlier (i.e., with less loss of water) when the percentage of salts in the cells has been increased by the absorption of salt from spray. In this way salt may be occasionally among the factors responsible for damage to foliage. The action of salt spray in extracting water from leaves would tend in the same direction, especially when the spray on the leaves becomes gradually more concentrated by evaporation,† the water extracted from the leaf being a loss to be added to that due to transpiration. On the other hand, cuticular transpiration would be stopped wherever liquid is present on the cuticle, and it must also be remembered that where spray is being evaporated the wind will be rendered less dry.

Conclusion.—The general conclusion from the foregoing considerations is that the scorching of foliage by sea-winds is chiefly due to the drying action of the wind, but that salt may perhaps occasionally contribute towards the production of an injurious effect.

* Blackman, *Vegetation and Frost*, *New Phytologist*, Vol 8 (1909), p 358

† Since reabsorption of water by the leaf tissues from the film of salt water on the surface of the leaf might thereby be prevented.

PESTS APPEARING DURING AUGUST.

Potatoes.—In last month's notes mention was made that potato diseases were largely in evidence in the country, and that *Blight* may still be very common if the weather should be damp. Growers should make every effort to dig and store their potatoes in dry weather, as if potatoes are clamped wet it is almost impossible to prevent the spread of ordinary potato disease in the clamp. In some districts it is frequently an advantage in the long run to grow Second Earlies, as these ripen and can be dug before the weather breaks. It is often desirable, at any rate in gardens, to dig the potatoes before the tops have died down, as the prospect of a heavier crop by leaving the potatoes in the ground may be negatived by the greater risks of disease. It is a general custom to leave potatoes on the surface of the ground for the skin to harden, and to let the tubers dry off before storing. If Blight is present in the adjoining rows, this should not be done, as the spores in the air settle on the tubers, and if left out over night especially the damp and dew may cause them to germinate. The tubers may thus become infected, and later, when the crop is clamped, the disease may spread and set up extensive decay in the whole clamp.

Leaf Curl—This disease arises from the use of poor or diseased seed. It does not always affect the entire crop, but occurs scattered in the rows, often to the extent of 25 per cent. to 50 per cent., and even more. Plants affected with Curl yield a very poor crop, and the tubers are of small size. *It cannot be too widely known that seed saved from such plants gives rise to similarly diseased plants, and the tendency is for the disease to increase in intensity each year.*

At this season it may still be possible to recognise the plants which are so affected, but later on this is not possible. Where "seed" saving is contemplated, therefore, an inspection should be made at once, and the presence and position of curled and "miffy" plants ascertained. If there is any appreciable quantity, no seed at all should be saved from the plot. *The rule that should always be followed in seed-saving is, to select from the most healthy plants* The common practice of allowing the entire crop to mature and then to pick out tubers of seed size cannot be too strongly condemned. It usually results in the larger, healthy tubers from robust individuals being rejected and the majority of the seed which is saved being the product of

curled and "miffy" plants. On light, dry soils in the warmer parts of the country it is not advisable to save seed at all, as the above-mentioned diseases develop and spread more rapidly under such conditions. Further details as to Leaf Curl will be found in Leaflet No. 164.

Wart Disease may be prevalent to an increased extent during August. The disease may often be seen on the surface of the ground as a green corrugated mass at the base of the stems. Later, however, rotting sets in, leaving only a black mass, the spores of the disease having been washed into the soil. When the potatoes are in this condition they should be taken up at once, and the warty material destroyed.

Corky Scab may also be found among the tubers. In appearance it resembles a bad attack of ordinary scab or rust, but the tendency is for the disease to appear on protuberances or on the end of the tuber, the affected surface being powdery. This disease has been known entirely to spoil a crop, but although of general occurrence, it is seldom serious except in damp spots and in certain soils. Lime, so useful against many soil diseases, does harm in this instance, and should be avoided.

Vegetables.—Another soil disease is the "Linger-and-Too" or "Club Root" of the *Brassicas* and turnips. This is well known all over the country by the deformation of the roots of attacked plants. It is often very difficult to eradicate but seems only to flourish in acid soils, and persistent and thorough liming will in time reduce, if not exterminate it. In bad cases it is of little use merely to scatter lime over the soil; what is required is a heavy dressing, in some cases up to 4 tons to the acre. Care should be taken in thus treating the soil not to re-infect it by feeding animals on infected material, as the spores will pass unchanged through the animals and be spread with the manure. Farmers should always be careful that they do not sow from the seed of infected plants.

Much confusion is often caused by the similarity in appearance between the galls of the turnip gall weevil and those in "club root." In the case of the weevil the galls can be opened, and the larvæ are visible within. Where weevils are present in the crop the turnip should be consumed as soon as possible, when the pest will be destroyed, while the land should be deeply ploughed to bury and so destroy any insects which have escaped. Stumps and roots should not be left about, as the insect can then complete its life history on them, and is ready to attack a fresh

crop in the following season. It is quite common for both the turnip gall weevil and "club root" to be present in the same root.

Fruit.—Although little can be done now to check the fruit diseases which are prevalent, it may be well to note for future guidance the treatment which should be adopted for certain diseases.

Plum trees which show signs of *Silver Leaf* should be marked, if it is not possible to deal with the disease at the moment. Where only a branch is infected, this should be cut off at once well back, so that no brown stain is visible in the wood. The cut surface should be treated with Stockholm tar. Trees that are completely diseased should be cut down either at once or in the winter, as if left they only die and produce spores which will infect other trees. It may here be pointed out that under the Silver Leaf Order, 1919, it is compulsory for growers to remove all dead wood on plum trees before the 1st April of each year.

Many apples will be found marked either with sooty blotches, or, in the case of varieties such as Cox's Orange, and also, more frequently, in pears, with deep cuts and cracks. This blotching is due to the attacks of the *apple* or the *pear scab*, and is the cause of great loss of fruit every year through disease, while the value of saleable fruit is depreciated by its bad appearance. It is now too late in the season for remedial measures to be of much benefit, but thorough and careful pruning in winter will remove much of the fungus in its hibernating form, and by spraying with Bordeaux mixture or lime sulphur before and after blossoming in spring a clean crop can be obtained. Full particulars are given in Leaflet No. 131.

Bushes which are affected with *American gooseberry mildew* should now be treated by "tipping" the diseased shoots on the older bushes, as no further growth may be expected. Infection of the soil by the falling winter spores may in this way be prevented. Young bushes, however, should not be tipped until later, except on hot soils, as fresh growth is very liable to develop and become infected with mildew.

In some districts the common *strawberry leaf spot* is very severe. The damage caused by this disease may be checked if loose straw is spread over the fields and fired. The diseased leaves are thus burnt without the crowns being injured, and new leaves will appear free from the disease.

FEEDING STUFFS IN AUGUST.

PROFESSOR T. B. WOOD, C.B.E., M.A.,

The Animal Nutrition Institute, Cambridge University.

SINCE the last issue of these notes in the May number of this *Journal*, the writer has received a considerable amount of correspondence on the subject of the meaning of *Food Units* and *Starch Equivalent*, from which it is evident that the use of these two terms causes much confusion. It has been explained on previous occasions that the value of a feeding stuff is two-fold: it possesses (1) a certain food value and (2) a certain manurial value. The method of calculating the number of food units in a ton of any feeding stuff takes this double value into account, and the cost per food unit therefore gives a measure of the total value.

Since, however, the idea of food units includes both manurial and food value, it is not possible to feed according to food units. This has been pointed out in these notes on several occasions, when it has been suggested that feeding should be regulated according to starch equivalents. To buy on the food unit system and to feed according to starch equivalents is certainly confusing.

The writer has therefore decided to work out prices on the starch equivalent basis in future, so that this confusion may be avoided. This course is possible now that the figures in the tables of manurial values of feeding stuffs, published in Bulletin No. 78 of the University of Leeds and the Yorkshire Council for Agricultural Education,* have been brought up to date. The method of calculation is to deduct the manurial value from the market price so as to get the net cost of the feeding stuff less manurial value, and to divide this net cost by the starch equivalent so as to get the net cost of one unit of starch equivalent. As in the case of food units, one unit is one-hundredth part of a ton, or 22 4 lb.

Before giving the table in which the calculation is made it is desirable to explain once more what the term "starch equivalent" means as used in this connection. This term has been used in several different senses; mostly to denote a theoretical food value determined by calculation. *As used in these notes "starch equivalent" means the number of pounds of starch required to produce as much fat in a store animal as 100 lb. of the feeding stuff in question.*

*These figures were published in this *Journal*, May, 1920, pp. 190 & 191.

Starch equivalents have been measured by direct experiment: the method may be illustrated by the case of a store bullock. The animal is first kept on what is known as a maintenance ration, that is to say, a ration which will just keep him going without gain or loss in weight. To this ration is then added a weighed quantity per day of starch. The animal increases in weight and puts on fat, and the amount of fat put on is accurately measured. It is found that for every 4 lb. of starch consumed, 1 lb. of fat is produced. The animal is again put on its maintenance ration until its weight is once more steady, when a weighed quantity of, say, linseed cake is added to the ration. Once more the animal increases in weight, and the fat laid on is measured. It is found that to produce 1 lb. of fat 5 4 lb. of linseed cake are required. For purposes of fattening, therefore, 4 lb. of starch are equivalent to 5 4 lb. of linseed cake, and 100 lb. of linseed cake are therefore equivalent to $\frac{4 \times 100}{5.4}$ = 74 lb. of starch. The starch equivalent of linseed cake is therefore 74 lb. per 100.

The starch equivalents of a number of the more important feeding stuffs have been found by direct experiments of this kind, and from these the starch equivalents of all the common feeding stuffs have been estimated. The accepted figures are given in one of the columns of the table below. They are accepted

Name of Feeding Stuff	Price per Qr of lb	Price per ton	Manuual Value per ton	Net Cost of Food per ton	Starch Equiv	Cost per Unit of Starch Equiv	Cost per lb of Starch Equiv
			£ s				d.
Barley, English feeding	90/- 400	25 0 0	1 6	23 14 0	71	6 8	3 60
" Foreign	80/- 400	22 10 0	1 6	21 4 0	71	5 11	3 17
Oats, English	72/- 336	34 0 0	1 9	22 11 0	59 5	7 5	4 10
" Foreign	65/- 320	22 15 0	1 9	21 6 0	59 5	7 2	3 84
Maize, Argentine	72/- 480	16 15 0	1 5	15 10 0	81	3 10	2 06
" American	90/- 480	21 0 0	1 5	19 15 0	81	4 11	2 04
" American	100/- 480	23 10 0	1 5	22 5 0	81	5 8	2 05
Beans, Chinese	19/- 112	19 0 0	3 1	15 19 0	66	4 10	2 60
Peas, English blue	22/- 100	22 10 0	3 18	19 17 0	69	5 11	3 17
Millers' offals—Bran	14 10 0	14 10 0	2 10	12 0 0	45	5 4	2 87
Coarse middling	15 10 0	15 10 0	2 10	13 0 0	64	4/-	2 15
Meals—Barley meal	23 10 0	23 10 0	1 6	24 4 0	71	6 10	3 67
Maize	20 0 0	20 0 0	1 5	18 15 0	81	4 8	2 52
Rice	22 0 0	22 0 0	2 0	20 0 0	72	5 6	3 05
Bean	22 0 0	22 0 0	3 1	18 19 0	86	5 8	3 05
Cakes—Linseed	21 0 0	21 0 0	3 12	17 8 0	74	4 8	2 52
Cotton seed	12 10 0	12 10 0	3 5	9 5 0	42	4 4	2 32
" decorticated	20 0 0	20 0 0	5 6	14 14 0	71	4 2	2 23
Cocoonut	13 0 0	13 0 0	3 0	10 0 0	79	2 6	1 34
Groundnut	13 10 0	13 10 0	3 9	10 1 0	87	3 8	1 87
" decorticated	18 0 0	18 0 0	5 5	13 15 0	73	3 6	1 57
Palm kernel	11 10 0	11 10 0	2 1	9 9 0	75	2 6	1 34
Brewers' grains, dried	11 0 0	11 0 0	3 7	8 13 0	49	3 6	1 57
" wet	1 12 6	1 12 6	12	1 0 6	16	1 4	7 2
Distillers' grains, dried	12 0 0	12 0 0	2 16	9 4 0	87	3 3	1 75
" wet	1 15 0	1 15 0	13	1 2 0	16	1 5	7 6

because rations compounded from these figures are found to be successful, not only in the case of fattening animals but for store stock, working horses, milch cows, and other animals.

In the table the price per unit of starch equivalent is worked out as follows: from the price per ton is subtracted the manurial value assessed at twice the figure given by Dr. Crowther in the Bulletin No. 73 of the Leeds University, above mentioned, to allow for the increased cost of manures. This gives the net cost of the feeding stuff per ton. This amount is then divided by the figure for starch equivalent, and the result is the cost of one unit of starch equivalent, exclusive of manurial value. By dividing the cost per unit of starch equivalent by 22.4, the cost per lb. of starch equivalent is found. This is a useful figure for computing the cost of a ration which is given in lb. of starch equivalent.

During the last two or three months there has been a considerable rise in the price of the cheaper feeding stuffs. Palm kernel cake, for instance, has risen £3 per ton, and millers' offals £1 per ton. This rise has, however, not extended to the more expensive feeding stuffs, such as barley, oats and linseed cake. The cereals are still the dearest class of feeding stuffs, costing, as a rule, over 9d. per lb. of starch equivalent. The cheapest cereals at the present time are maize and coarse middlings. In comparison with cereals, cakes are relatively cheap; all cost less than 9d. per lb. of starch equivalent. Palm kernel is still the cheapest cake on the market, in spite of its recent rise in price.

It does not seem opportune at the present time to give rations, while most of the live stock are out at grass, but the list of prices may be useful to those who intend to buy in their feeding stuffs for the winter.

NOTICES OF BOOKS.

The World's Food Resources—(J. Russell Smith. London: Williams & Norgate. 18s. net.).—At a time when very general interest, and in some quarters alarm, is felt in regard to the food supplies of the world, this book, by the Professor of Economic Geography in Columbia University, is opportune. Although it has only recently reached this country, it appears to have been completed at the end of 1918, and the author, in a prefatory note, remarks that "the problem of statistical illustration" was peculiarly unsatisfactory, as "conditions during the period 1914-18 were so disturbed that production figures would not serve as good illustrations."

Consequently, the statistics with which the book is crowded do not usually relate to a later period than 1913, although many allusions are made to the lessons to be derived from war-time experience. It would not be difficult to pick out from the voluminous statistics given certain figures of doubtful validity, apart from the common defect of including in the same table, and without qualification, figures of diverse degrees of accuracy. This, however, is almost inevitable in a broad survey which attempts to take into account the present and potential food resources of the whole globe. It is this breadth of view which renders the work especially valuable. It is refreshing to turn from the prevalent ratiocinations, based on temporary and local conditions, to a comprehensive review of all continents and climes. Whether the conclusions of the author are accepted in every detail or not, he at least brings the problem of future food supplies into reasonable proportion.

Starting with a discussion of wheat, which he says is the most highly prized breadstuff, not because it is the most nutritious, but "because wheat bread tastes a little better to most people than other breads," and after pointing out the wide range of climatic conditions under which it can be grown, he refers to the immense areas which are still open to its extension, and also to the great possibilities of increased yield per acre. He adds rye, barley and oats as almost equally suitable for bread, and indicates the wider range given by their inclusion as breadstuffs. Maize, on the whole, is not capable of much extension of area, but the cultivation of rice may easily be doubled or trebled. A number of minor cereals, such as millet, which is the chief cereal crop of Central and North China, are also passed in review.

A discussion of the distribution of cattle, sheep and swine leads to the general conclusion that the world's meat supplies are almost within sight of their ultimate limit of extension, and the wastefulness of meat production, if vegetable resources are limited, is insisted upon. The author, however, holds the view that of all the main articles of food, meat is the least essential, and he points out that countless millions of the human race live and flourish without it. Consequently, he holds that the consumption per head of meat-eating peoples could be greatly reduced without detriment to their health and vigour. So far as milk is concerned, the author insists strenuously on its dietetic value, and is of opinion that an enormous increase in present supplies is mainly a question of transportation, which the refrigerating chamber and the invention of processes for drying have simplified.

Professor Russell Smith is especially interesting in calling attention to new and as yet partially developed sources of food. He opens a notable chapter on

Fish Supply thus :—"The Sea ! We have not discovered it yet. If man insists on eating animal proteins and wants a twenty-fold or a hundred-fold increase in the supply, I call his attention to the sea as a place where he may drop his prejudice overboard, investigate, and probably find food in amounts that are beyond present computation." The very recent discovery of the adaptability of vegetable oils as a source of fat supply is described in detail and illustrated by imposing trade statistics which are unquestionable. We are reminded that sugar, which now bulks so largely in our normal dietary, is of recent introduction. "Sugar has been all around us for countless ages but we did not know how to get it"—only the bees possessed the secret. The author draws the moral—"The appearance and use of sugar afford a good example of the service of science to man and of the changes that we may expect in our food supply."

Allusion has been made to the possibility of criticism in detail, and it is perhaps desirable to mention one or two points which affect this country. One is the repetition, by inadvertence, of the common, but erroneous, statement that England before the War produced "but a fifth of the *food* she ate"—the reference being of course to wheat alone. In a description of international trade in meat supplies, the importation by the United Kingdom of live animals is mentioned as if it still continued. In a section dealing with the future wheat supply of the world, a curious error, in which I have some personal interest, is made. Referring to the "alarmist paper" of Sir William Crookes, the author has a footnote which states that Lord Rhondda brought out a new edition of Crookes's book "with this frightened statement": "England and all civilized nations stand in deadly peril of not having enough to eat." This is followed by further extracts of similar purport. In fact, this statement was not made by Lord Rhondda, but by Sir William Crookes. The preface which Lord Rhondda contributed to the book contained no sign of "fright," although it endorsed the useful advice given by Sir William Crookes, that the aid of science should be enlisted in stimulating production, especially in this country. I may be permitted to add, that having known Lord Rhondda for many years and sat with him on the Council of the Statistical Society, I can testify to the soundness of his views on statistical subjects, and I may perhaps add that he would not have asked me to write a supplementary chapter to Sir William Crookes's book if he had thought it necessary to express "frightened" opinions.

But it is not by small points such as these that this book should be judged. In a chapter headed "The Ultimate Food Supply," the author's main contention is thus stated :—

"It has been shown in connection with nearly every article of diet save meat that we can easily and greatly increase the supply in the Western World. Nevertheless, it is perhaps worth while to consider the general question of the future food supply, because it is so generally believed that the chances of making a living are growing fewer, that the resources of the world for each man are less than they were a few years ago. This belief is not founded on geographic or scientific fact ; it belongs in the same class with the idea in the mind of the horse when he sees a bar in front of him and he thinks he is fenced in, although he could easily tear down the fence with his soft nose. If resources appear to be growing scarce, the scarcity is due to the shortcomings of our suddenly

grown financial and industrial system, and from our quite unscientific method of distributing goods and wealth and holding property. It is true that the world has a fixed area, and that the number of mankind, despite the temporary destruction wrought by the Great War, is increasing very rapidly; but while the area is stationary and the material in the world is constant in quantity, the usable resources are also rapidly increasing. A resource is something which may be turned into or made to produce a useful commodity. Science every day enables us to have some new commodity, where before there was waste. Because of this creation, there is good reason for the belief that the available resources of the world are increasing quite as rapidly as the population, and that they will continue to do so for a number of generations, if man devotes himself to science and industry rather than to war."

The book may be commended as a comprehensive and well-informed world survey of the subject with which it deals, to all who take a serious interest in food supplies.

R. HENRY REW.

The Small Farm and its Management.—(James Long. London: John Murray, 1920. 7s. 6d. net).—The revised edition of this volume by James Long will prove a useful guide to the ever growing body of men and women engaged in or contemplating the business of small farming. The attractions and difficulties of the life are set out clearly and impartially. To be successful, the small farmer must be prudent and industrious; he must be equipped with the necessary capital and experience; and he must pursue the methods of husbandry best adapted to the cultivation of a few acres. The road to success and the pitfalls to avoid by the way are indicated in simple and intelligible language that inspires confidence and interest.

In general, the author would pin his faith to milk and its products, to pig meat, poultry and eggs, to such crops as are necessary for feeding purposes, and to a selection of other crops for direct sale to the consumers. He believes in the plough policy for the small farmer, with a strong leaning towards arable dairying through the medium of soiling crops.

Excellent advice is given in regard to the choice of land. Heavy land, though cheap, requires men of much experience and large capital. What is wanted is sound, clean, medium land. The small farmer has neither the time nor the capital to make poor land fertile, and to a beginner land-cleaning is a heart-breaking job.

In the section dealing with crops the large as well as the small farmer will find much to interest and stimulate; the note on sainfoin is specially appropriate at the present time.

Implements, general equipment, and marketing in the light of modern requirements, likewise receive due attention, and the entire volume may be described as at once simple, comprehensive, practical and explanatory.

J. G. S.

The Electrification of Seeds by the Wolfryn Process—A Report of the Experiments carried out at Reading in 1919. (Martin H. F. Sutton, F.L.S. Reading: Sutton & Sons. 2s. 6d. net).—A number of experiments have been conducted during the last few years with seeds electrified under the Wolfryn process, in order to test the possibilities of obtaining increased yields from seeds treated by this method. The Wolfryn treatment, which was described

in some detail in an article published in the issue of this *Journal* for January last, consists in immersing the seeds in a solution of common salt and water (4 oz. to the gallon) or calcium chloride and water (8 oz. to the gallon), and applying an electric current to the solution, and afterwards drying the seeds at a temperature of 100° F.

The experiments conducted by Mr Sutton and described in his small pamphlet were intended to ascertain (a) whether the process is sufficiently beneficial as regards results to justify the expense it entails, (b) whether the benefit is due to the process as a whole, including the use of electricity, and (c) whether equally satisfactory results could be obtained by immersion of the seed without the use of electricity. With this object comparative tests were made of seeds untreated in any way, seeds treated by the Wolfryn Process, and seeds treated in the same manner as under the Wolfryn Process except for the actual electrification, which was omitted. The experiments included both a germination test under glass and a field test, and the seeds used were carrot, swede, cabbage and mangold. In the opinion of the author the results in both cases could only be regarded as inconclusive, one or two points only being slightly in favour of the electrified seed. The outdoor tests as a whole appeared to be no more conclusive than were the tests for germination, the returns from the electrified seed showing no advantage over the other sections, except to a small extent in the case of mangolds.

QUESTIONS IN PARLIAMENT.

Foot-and-Mouth Disease—In reply to a question by Capt Coote, it was stated that the number of animals slaughtered during the last 3 months in connection with the outbreaks of foot-and-mouth disease was cattle, 772, sheep, 5 265, pigs, 271, goats, 2 (13th July, 1920)

Milk Prices in Wiltshire—In reply to a question by Capt R Terrell, the Food Controller stated that he was informed that the average price received by producers of milk in the South-Western area during May and June was 1s 2d per gallon. The price in this area was governed by the fact that a considerable proportion of the milk produced at this season was not retailed as liquid milk, but had to be converted into cheese, and other milk products (15th July, 1920)

Potato Spraying—In reply to a question by Mr Jordell, in reference to an alleged difficulty in adequately spraying potatoes in West Norfolk on account of the shortage of sulphate of copper, it was stated that the Ministry exercised no control over the production or distribution of sulphate of copper. No information had reached the Ministry which would indicate that supplies were insufficient to meet the demand, provided that consumers were prepared to pay the market price (15th July, 1920)

Tenure of Allotments.—In reply to a question by Mr Hallas, who inquired whether the Ministry is receiving representations from Associations of Allotment Holders, praying for security of tenure to be afforded to the allottees, and what steps it is proposed to take in the matter, it was stated that the Ministry was aware of the desire of allotment associations and allotment holders for security of tenure. Absolute security of tenure for allotment holders could only be secured by the land being purchased by the local authority or by the allotment holders themselves, but the capital value of

land in the neighbourhood of a town, due to its value for building, was, as a rule, too high to enable the land to be purchased for allotments, inasmuch as the allotment holders could not afford to pay a rent based on the cost. In such cases the only alternative was to hire the land until it was required for building, in which case it was clearly impossible to guarantee the allotment holders absolute security of tenure. (20th July, 1920.)

Ormskirk Potato Trials.—It has now been arranged that the summer inspection of the growing crops of potatoes planted for the Ormskirk Potato Trials shall take place on 10th, 11th, 12th and 13th August. Inspection on the first two days is by invitation from the Ministry and from the National Institute of Agricultural Botany, but the Trial grounds will be opened on the 12th and 13th to all interested in potato growing. The Trials, which in the past have been entirely under the direction of the Ministry and have been carried out on the grounds of the Ormskirk Institution, kindly loaned by the Guardians for that purpose, have now been transferred to the farm at Lathom, Ormskirk, recently purchased by the National Institute of Agricultural Botany. The Ministry will still retain responsibility for testing potatoes for susceptibility to or immunity from Wart Disease, and have extensive plots of potatoes planted on the farm for this purpose, including a large number of varieties from America, France, South Africa and New Zealand. They have also a considerable number of seedlings from breeding Institutions, potato raisers, and others.

Trials for other purposes will be carried out by the National Institute of Agricultural Botany, which this year has planted a very large number of demonstration plots of most commercial kinds of immune varieties of potatoes. These should prove attractive.

Rabies.—All restrictions on the muzzling and movement of dogs imposed in connection with the outbreaks of rabies in South Wales, in Oxfordshire and Buckinghamshire, in Kent, and in Surrey and Middlesex, have now been withdrawn.

The North Essex Scheduled District, comprising Colchester and the district between that town and the coast towns from Harwich to Brightlingsea, is the only district which is now subject to the restrictions on account of rabies.

Leaflets issued by the Ministry.—Since the date of the list given on page 298 of the issue of this *Journal* for June last, the following leaflet has been issued in the *Permanent Series* :—

No. 351.—The Improvement of Village Life.

In addition, the information in the following leaflets has been revised and brought up to date.

No. 15.—The Apple Blossom Weevil.

„ 42.—The Short-eared Owl.

„ 45.—The Starling.

„ 51.—The Barn Owl.

„ 67.—Favus or White Comb in Poultry.

„ 200.—Black Rot of Cabbages, Turnips, &c.

„ 210.—The Oyster-Shell Scale.

The following leaflet has been withdrawn from circulation :—

No. 256.—A Disease of Narcissus Bulbs.

Weather Forecasts for Farmers.—The Meteorological Office will, as in past years, supply forecasts of weather by telegraph to persons desirous of receiving them, upon payment of a registration fee of 1s. and the cost of the telegrams, computed at 1s. per message.

The forecasts are drawn up at 10.30 a.m., 4 p.m., and 9.0 p.m. (summer time). Forecasts issued at the morning hour refer to the period covering the afternoon of the day of issue and the morning of the following day. Those issued in the afternoon and evening refer to the whole of the following day. All the forecasts include a Further Outlook of the probable weather beyond the 24-hour period whenever such a Further Outlook can be given.

Notifications will also be issued by telegram when conditions indicate that a spell of several days fair weather is likely, and again when the spell is about to break up. For this service a fee of 6d. is charged for telegraphy. A minimum deposit of 5s. against which the charges may be booked is required.

Applications for regular forecasts (as distinct from Spell of Notifications) should specify the hour of the forecasts desired (or hours if more than one telegram daily is required). They should be sent to the Director, Meteorological Office, Air Ministry, London, W.C.2, and should be accompanied by a cheque or postal order payable to the Meteorological Committee to cover the cost of the telegrams for the period during which the forecasts are to be sent.

Further particulars and printed forms of application may be obtained from the Director of the Meteorological Office.

Applications by telegraph for single forecasts shall be addressed to "Weather, London," and the reply should be prepaid.

Removal of Prohibition on the Export of Live Stock.—The Ministry is informed that an export licence from the Imports and Exports Licensing Section of the Board of Trade is no longer required in respect of living animals, for food, of all kinds, live game and live poultry, exported from this country, except to Bolshevik Russia.

Re-exportation of Horses from France.—According to a note published in the *Journal Officiel* (Paris), 21st May, 1920, the following decisions have been made by the French Government.—

1. For horses coming from abroad and only passing through France in direct and immediate transit, it shall no longer be necessary to obtain a permit from the Minister of Agriculture as a preliminary to re-exportation.

2. Horses coming from abroad will be allowed to stay in France and be re-exported within a period not exceeding six months, without incurring liability to Customs duties, on condition that the importers obtain from the Veterinary Service of the Customs Office at the port of importation a separate certificate indicating the breed, sex, age and detailed description of each animal. This certificate shall then be forwarded for confirmation to the Customs Export Office. It will, as in the case of (1) above, not be necessary to obtain a permit from the Minister of Agriculture before re-export.

Export of Oil Cake from France.—In the issue of the *Journal Officiel* for 2nd July is published a Presidential Decree, dated 30th June, affecting the export of oil cake from France. Under the terms of the Decree the export of oil cake and brewers' grains (*drèches*) remains prohibited, except under licence, and it is provided that, when such cake is allowed to be exported under

licence, an export duty is to be levied thereon at the rate of 25 francs per 100 kilogs (about 2 cwt.) net weight.

From the preamble to the Decree it appears that, owing to the stocks which have accumulated, it is intended to allow the export of oil cake during the summer months, up to amounts to be fixed by the French Ministry of Agriculture, for each month.

Restricted Importation of Lucerne Seed. The issue of *The Commonwealth of Australia Gazette* for 25th March last contains a copy of a Proclamation, dated 19th March, 1920, prohibiting, except with the consent in writing of the Minister of State for Trade and Customs, the importation into the Commonwealth of lucerne seed unless such seed is stained with safranin to the extent of not less than five per cent. of its total bulk.

ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous—

- Fream, W.*—Elements of Agriculture (10th Edition), (700 pp.). London : John Murray, 1919, 7s. 6d. net. [63(022).]
- McCullum, E. V.*—The Newer Knowledge of Nutrition : The Use of Food for the Preservation of Vitality and Health (190 pp.). New York : The Macmillan Co., 1919, 6s. 6d. net. [612.39]
- Saskatchewan Department of Agriculture.*—Bull. 57 : —Weeds : Their Identification and Control (2nd Edition), (62 pp.). Regina, Sask., 1919. [63.259(04).]
- South Carolina Agricultural Experiment Station.*—Bull. 202 : —Trona Potash : A Progress Report (24 pp.). Clemson College, S.C., 1920. [63.1673.]
- Lange, J. E.*—Vilde Planter I Have, Paa Mark og Eng. (26 pp.). Kobenhavn Chr. Cato, 1913. [58.19.]
- Canada, Ministry of Agriculture.*—Sessional Paper 10. —Report of the Dominion Experimental Farms for the Fiscal Year ending March 31st, 1919 (196 pp.). Ottawa : 1920, 15 cents. [63(06) (71).]

Dairying—

- Martiny, B.*—Der Wassergehalt der Butter (963 pp.). Berlin : Paul Parey, 1898. [63 721.]
- Frederiksen, J. D.* The Story of Milk (188 pp.). New York : The Macmillan Co., 1919, \$1.50. [63 71(02).]
- Belgium, Ministère de l'Agriculture.*—Actes du Conseil supérieur de Perfectionnement de l'Enseignement agricole. Fascicule I. (67. pp.) Bruxelles, 1920. [87(493).]
- Grieve, Mrs. M.*—The Soil and Its Care. A Treatise on the Care of the Soil, Digging, Manuring, Drainage, &c. Chalfont St. Peter, Bucks. : The Whins Medicinal Herb School, n.d., 2s. net. [63.1.]

Field Crops—

- Buller, A. H. R.*—Essays on Wheat, Including the Discovery and Introduction of Marquis Wheat, Early History of Wheat-Growing in Manitoba, Wheat in Western Canada, Origin of Red Bobs and Kitchener, and the Wild Wheat of Palestine (399 pp.). New York : The Macmillan Co., 1919, \$2.50. [63.811.]
- Fraser, J.*—Twentieth Century Potatoes. A List of Commercial Varieties of the Past Forty Years, with Full Description of Their Origin, Characteristics and Awards (72 pp.). London : Cable Publishing Co., n.d., 3s. net. [63.512.]

SELECTED CONTENTS OF PERIODICALS.

Agriculture, General and Miscellaneous—

- The Use of Agricultural Land, *Sir R. H. Rew.* (Nineteenth Century, May, 1920.) [63.]
- The Formation of Nitrates in Soil, *T. L. Lyon.* (Soil Science, Vol. IX., No. 1, Jan., 1920.) [63.113.]
- The Feeding of the United Kingdom, *Sir R. H. Rew.* (Jour. R.A.S.E., Vol. 80, 1919.) [338.1 63(42).]
- Economie de main-d'œuvre agricole par l'emploi de Machines et de méthodes modernes, *E. Leprieux.* (Revue Agronomique, Mars-Avril, 1920.) [33.63.17 (493).]
- Reaction of the Soil as influenced by the Decomposition of Green Manures, *L. P. Howard.* (Soil Science, Vol. IX., No. 1, Jan. 1920.) [63.113.]
- Some Problems of Reconstruction in Agriculture, *A. Smetham.* (Jour. of Royal Lances. Agric. Soc., 1919.) [338.99.]

Horticulture—

- Plant Sanitation in Fruit Plantations, *F. T. Brooks.* (Trans. Brit. Mycolog. Soc., Vol. VI., Part III., April, 1920.) [63.29.]
- Science and Fruit Growing, *F. Keeble.* (Edinburgh Review, April, 1920.) [63.41(42).]

Live Stock—

- Le Cheptel français et colonial à la fin de la guerre, *G. Moussu.* (Ann. de l'Inst. Nat. Agr., Series II., Tome 14.) [63.6.33(44).]
- Open-Air Pig Breeding, *M. J. Rowlands.* (National Review, April, 1920.) [63.64.]

Plant Diseases—

- Halo Blight of Oats, *C. Elliott.* (Jour. Ag. Res., Vol. 19, No. 4.) [63.23.]
- Amount of Copper required for the Control of Phytophthora Infestans on Potatoes, *O. Butler.* (Phytopathology, Vol. 10, No. 5) [63.294.]
- Biological Control of Mealybugs in California, *H. S. Smith and H. M. Armitage.* (Bull. Dept. of Agric. Calif., No. 4, Vol IX, April, 1920.) [63 29.575.4(73).]
- Insect Transmission in Plant and Animal Diseases, *F. V. Rand and W. D. Pierce.* (Phytopathology, No 4. Vol. X.) [63 2.]
- On Forms of the Hop resistant to Mildew, *E. S. Salmon.* (Annals of App. Bio., Vol. 6, No 4, April, 1920.) [63.3451.]

Dairying and Food, General—

- Pepsin versus Rennet in Cheesemaking, *H. M. Merker.* (Jour. of Dairy Science, Vol. II., No. 6) [63.73.]
- Milk and its Products, *E. McKinnon.* (Jour. of Comm. Inst. of Sci. and Ind., Vol. 2, No. 4, April, 1920.) [63-715.]
- Mottles in Butter—Their Causes and Prevention. (Jour. of Dairy Science, Vol. III., No. 6.) [63.726.]

Veterinary Science—

- Intoxication provoquées par des tourteaux d'arachides contenant de petites quantités de ricin, *G. Moussu.* (Comptes rendus des séances de l'Acad. d'Agric. de Fr., 5 May, 1920.) [543.1, 63.604.]

Engineering—

- Rapid and Economical Methods of House Building: Pisé de Terre, *C. Williams-Ellis.* (Jour. of Commonwealth Inst. of Sci. and Ind., Vol. 2, No. 4, April, 1920.) [69.]
- The History of the Silo, *L. Carrier.* (Jour. Amer. Soc. of Agron., Vol. 12, No. 5.) [894.]

THE JOURNAL OF THE MINISTRY OF AGRICULTURE

Vol. XXVII. No. 6.

SEPTEMBER, 1920.

NOTES FOR THE MONTH.

It has long been a tradition of farming that two white-straw crops should not be grown in succession, and the tradition still

Continuous Wheat Growing.

lives although it is generally known that there are numerous cases in which the practice has been a success. The classical proof that white-straw crops can follow one another without deterioration of the land is afforded by experiments at Rothamsted Experimental Station, where wheat has been grown continuously on the same land for 73 years, with only two seasons' break for fallow, and barley has been grown for 63 years with only one season's fallow. In similar experiments at Woburn, on a much lighter soil, forty-four crops of wheat have been taken off the same land without any break, and forty-four crops of barley off the barley plots. As a commercial proposition, wheat was grown almost continuously for 50 years on Mr. Prout's land at Sawbridgeworth. Other instances are also known, particularly on chalky boulder clay, where wheat has been grown for a succession of years on the same land, and it may be taken as proved that the practice is quite feasible.

In the case of the continuous wheat crops at Rothamsted there has, of course, been a falling off on the unmanured land, but this is less than might have been expected; for the last 40 years the yield has been fairly steady, and has averaged $11\frac{1}{2}$ bushels, against $17\frac{1}{2}$ bushels for the first five years of the experiment. The plot supplied with farmyard manure shows no falling off, but on the contrary, a rise; for the first eight years the yield averaged 28 bushels, and for the last ten years 35 bushels. Except in a few really bad years, such as 1879, 1904 and 1912, the crop has been consistently good; while

often, as in 1892, 1893 and 1900, it has still been good in spite of the big drop in the average yields for the whole country. The most interesting plot for the present purpose, however, is that supplied with complete artificials. For the first 30 years the yield was well above that on the dunged plot. It has fallen off since, but it was maintained for a sufficiently long period to show that no falling off need be anticipated in practice.

The advantages of rotations are so obvious that no one would advocate any general suspension, but there are, in the South of England, large areas of clay land where the possibility of introducing some system of continuous wheat growing in which both grain and straw would be sold is a matter for serious consideration. In such counties as Essex, Hertford and Middlesex, for instance, there is a ready sale for straw. Farm buildings for the winter feeding of stock are often lacking or are at best inadequate, and the difficulties attached to growing roots on the heaviest soils make the winter fattening of stock on ordinary lines quite out of the question. The productivity of such soils under wheat can be maintained for any length of time by comparatively inexpensive dressings of artificial manure, and autumn is the one season in which it is safe to rely on being able to sow any crop. The only real difficulty lies in keeping the land clean and in getting through the necessary cultivation in the short period between the harvesting of one crop and the sowing of the next. To overcome both these difficulties it is practically essential to be able to command steam tackle. If this is available as soon as harvest is over, the autumn cultivation presents no special difficulty in an average season, and by its aid any fallowing which may be required is cheaply and effectively performed.

With proper management a really bare fallow will seldom be necessary. As the land shows signs of becoming too foul for autumn treatment to suffice, clover may be sown down in the wheat and cut for hay early in the following season. An alternative plan is to sow crimson clover or winter oats and vetches in autumn. In either case the hay or silage crop will be cleared by the beginning of July, and the land may then be half fallowed.

A crop of beans sown in rather wide rows, say 30 inches, and cleaned by horse and hand hoeing, answers the same purpose in a different way.

A modification of the system referred to is already practised

in certain chalky-clay areas of the south where arable sheep farming has gone out of fashion and where even bullocks are not fattened to the same extent as formerly. Under the changed conditions the proportions of the various crops would normally be as follows :—

Corn, mainly	Wheat	...	...	50 per cent.
	Clover	...	...	15 " "
	Beans	...	...	15 " "
	Bare Fallow	.	15	" "
	Roots, etc.	...	...	5 " "

Farming on these lines is suited to big holdings and large open fields, where labour-aiding machinery and implements can be used to the best advantage.

Provided artificials are used judiciously and in adequate amount, and provided also that the rotation contains a proper balance of clover, beans and other leguminous crops, and that the fallows are energetically and skilfully tackled, there need be no fear either of foul or of impoverished or of ill-working land under this system.

Manuring Wheat taken after Wheat or Another Corn Crop.—Generally speaking, farmyard manure would be better applied to such crops as potatoes, cabbages, mangolds, and even swedes and turnips, than to wheat. The latter crop, therefore, in most cases receives artificials alone. Generally some 2 or 3 cwt. per acre of superphosphate or 5 cwt. of basic slag should be applied before sowing the wheat, and from 1 to 1½ cwt. per acre of sulphate of ammonia or nitrate of soda as a top dressing in early spring. In some cases a satisfactory response would be obtained if larger dressings of nitrogenous manures were given.

When 1½ cwt. of nitrogenous manure per acre is applied, a small part (not more than ½ cwt.) of this might be mixed with superphosphate and given at the time the wheat is sown, or if basic slag is used instead of superphosphate, it may be given after the slag has been harrowed in. On no account should sulphate of ammonia and basic slag be mixed together. In any case the greater part of the nitrogenous manure should be given as a top dressing in spring.

Where land is known to benefit from potash fertilisers—usually light land and peaty soils—a dressing of 2 cwt. of kainit or 1 cwt. of 30 per cent. potash salts might be given.

Disposal of Straw.—The style of farming above described is, of course, mainly applicable at present where there is a sale for straw.

Recent work at Rothamsted has, however, demonstrated the possibility of synthetic production of farmyard manure from straw and artificials without the use of animals at all. The straw is allowed to decompose, forming humus, and the necessary nitrogen compound is supplied in the form of an ammonium salt. The details of the method are being fully worked out at Rothamsted.

IN view of the great need to grow more wheat at the present time, the following notes on the more important points **Sowing of Wheat.** which should be considered in sowing are in season :—

Preparation of Seed Bed—On the typical wheat soil of East Anglia—chalky boulder clay—the weight of evidence in respect of bare fallows or half-fallows seems to be in favour of preliminary deep cultivation, either by plough or cultivator, followed by more superficial workings to secure a deep tilth firm below and relatively loose and fine above. When this stage is reached further ploughing is deemed a mistake, as tending to promote “ root-fall ” and lodging of the crop.

After a fallow crop, for which the land has already been deeply tilled, fleet ploughing for wheat is the rule, but some farmers obtain excellent results by ploughing at least 8 inches deep and pressing afterwards. Following potatoes, cultivating without ploughing is a common and successful practice. So long as a firm, yet penetrable, bottom tilth, combined with a looser, freer tilth at the surface, is obtained, the mode of accomplishment appears to be relatively unimportant.

Seed—Trials show that so long as pure seed is maintained, the same stock may be used year after year on the same farm without risk of diminished productivity. In late wheat-growing districts a change of seed may be an advantage. Seed from an early district will be found to mature sooner and be less exposed to the dangers of a late harvest.

In every case the seed must be clean, healthy and of good germinating capacity. Every year many crops fail, either wholly or partially, through neglect on the part of the farmer to perform a simple germination test.

The question of the choice of variety is more difficult. One is better suited to a particular set of conditions than another. Local experience is generally the best guide, but farmers who have not yet tried “ Yeoman ” would be well advised to do so.

It is a heavy yielder of grain of superior quality, yet it is easily handled at harvest time, for its straw is moderate in amount and possesses exceptional standing power. There is probably no variety of wheat in general cultivation so well suited to rich land or so well adapted for yielding a profitable return on fertilisers.

Method and Rate of Sowing.—Only broadcasting and drilling need be considered. The former economises time and labour at the expense of a slightly greater quantity of seed: the latter economises seed and generally ensures a more uniform covering, but increases the cost of labour. The first renders hoeing and weeding of the crop impracticable; the second, particularly when the rows are wide enough apart, facilitates such operations.

Where there is sufficient tilth, the seed may be broadcasted and ploughed in, or, as in the case of large areas on the Downs, broadcasted by the machine fitted with cultivating attachment. From the standpoint of yield, there seems little doubt that drilling is preferable to either of those methods. Where the cart-wheel method is adopted, as in Kent, the broadcast seed is deposited on relatively wide ruts at a uniform depth and at intervals of 9 inches or so from row to row. In such circumstances individual plants have more room to develop than when compressed into a narrow seam, as is the case with some of the modern drills. Consequently, the crop stands up better at harvest and, though comparative data are lacking, there is no doubt that exceptionally heavy yields are obtained by the Kent method.

The question of the best depth of covering is likewise one on which no reliable data are available. A drill has recently appeared the principle of which is to distribute the seed thinly, (about $1\frac{1}{2}$ bushels per acre) by coulters, 8 inches wide and 9 inches apart, which barely enter the ground at all. The seed is lightly covered with soil by two cultivating attachments fixed behind each coulter, the effect being to leave the surface of the field in slightly raised ridges. The surface tilth required is much finer than that usually considered desirable for a crop which is to stand the winter, but no serious "capping" results, and the little that is found yields readily to a set of light "Parmiter" harrows run over the wheat in spring. Fertilisers are deposited in the row with the seed but do not come into direct contact with it. The result, as seen in a field near Chelmsford, is a wonderfully strong, upstanding plant with numerous tillers all the same length and with long, full ears of equal size. The general

appearance of the crop is in marked contrast with adjoining lots sown by other drills where the straw is finer and weaker, the ears shorter and many tillers only half developed.

Examination of the root systems of the several lots discloses interesting differences. In the case of wheat sown in the ordinary way there are two tiers of roots on each plant, one well below the surface level, the other near the surface. In the case of the new drill referred to, all the roots are practically at the surface; they are stronger and longer, the topmost acting as surface anchors after the manner of tree roots. These differences would seem undoubtedly to bear some relation to standing power. An important factor in crop production is the power of the straw to stand. If by practicable cultural methods this can be improved, an enhanced yield and a profitable return for liberal manuring would be rendered much more certain.

Over-thick seeding tends to weaken straw; on the other hand a very thin crop is likewise easily knocked down. The limit in the case of drilling seems, in general, to be between $1\frac{1}{2}$ and 3 bushels per acre. Where 2 bushels are drilled, possibly 3 should be broadcasted, but much depends on soil, climate, variety, and time of sowing. For broadcasting on the Kent system and under rich conditions, 7 pecks are considered enough for October sowing, and 8 to 10 pecks for November or December. Under the poorer and more exposed conditions of the Downs, up to $3\frac{1}{2}$ bushels per acre are sown. A useful motto is "Sow early and save seed."

* * * * *

In a report on the use of milking machines, prepared in 1917 for the Committee on the Production and Distribution of Milk

Milking Machines.

and printed in its Final Report, one of the conclusions stated is that "good results cannot be expected unless the parts of the machine which come in contact with the milk are thoroughly cleansed after each milking."

Dr. Thomas Orr, Medical Officer of Health for Ealing, in the issue of *Public Health* for March last, discusses the milking machine both in its general aspects and also from the point of view of clean, that is to say, bacteriologically clean, milk. After sketching the genesis of the milking machine, and paying a tribute to Dr. A. Shiels of Glasgow, whose machine, in 1891, was the first to be provided with the pulsating device to

imitate the natural sucking of a calf, the writer gives an account of the mechanism of the ordinary types. He then passes on to the question of the efficiency and suitability of the machine, and records his conclusion that it may be considered comparable with average hand-milkers. No reduction of the milk yield need be anticipated from its use. It is, however, advisable to strip the cows by hand after machine milking. If care is taken to apply teat-cups of the proper size, no injurious effect on the health of the cows or on the teats and udder need result. The saving of labour has been estimated at from 30 to 40 per cent., but it is not profitable to instal a milking machine for less than 30 cows.

Dealing next with the main question of his paper, the writer points out that milk produced under good conditions may contain less than 5,000 bacteria per cubic centimetre. The standard for certified milk in the United States is 10,000 bacteria per cubic centimetre. He quotes instances, however, of bacterial contents of machine-drawn milk "ranging from 71,000 to 395,000 . . . with as many as 1,208,000 bacteria per cubic centimetre . . . a bacterial content of 509,000 per cubic centimetre when the machine received only average care," and reinforces these by his own experiences of "two different machines giving milk with 494,000 and 1,392,000 bacteria per cubic centimetre respectively." Such figures, Dr. Orr remarks, may surprise the casual observer to whom a milking machine appears to be an ideal method of taking milk from the cow.

No doubt certain important sources of contamination are guarded against by the use of a milking machine, but other sources arise through the nature of the apparatus. Milking machines render milk liable to contamination from three sources:—(1) material from a diseased or gargety udder; (2) air and dirt sucked in when the teat-cups fall off; and (3) the serious contamination from the cups and tubes of the machine, which can be kept clean only by exercising the strictest care. Contamination from the first-mentioned source may be prevented by examining beforehand the teats and udder of the cow—this is an essential procedure in ordinary hand-milking. The second source is more difficult to deal with, but if the teats are kept clean and fitted with cups of suitable size, the risk of the cups falling off may be reduced to a minimum. It is the third source of bacteria which requires most attention. Great care should be taken to keep clean those parts of the machine with which the milk comes into contact, namely, the cup and its rubber parts, the "claw," the

milk tubes, and the receiver. It is at all times difficult to free these parts from the residual milk after the milking operations, and in summer, when the warm weather favours the multiplication of bacteria, special difficulty is likely to be experienced with machine-drawn milk. Cleansing or sterilising would be a more simple matter if boiling water or steam could be passed through the apparatus. While this can be done with the metal parts, it is impracticable with the rubber linings and tubes, which would quickly perish under such treatment. It is, therefore, necessary, in order to ensure cleanliness in production, for each part of the machine to be detached and cleansed separately in a particular way.

Experiments have suggested that the best liquid for cleansing the rubber parts is a solution of brine and chloride of lime; 10 lb. of common salt and $\frac{1}{4}$ lb. of chloride of lime added to 7 gallons of water have been recommended. As this solution deteriorates, chloride of lime should be added each week. The procedure in cleansing is first to wash out the machine by sucking clean water through it, followed by warm soda water to get rid of any trace of milk and to prevent the deposition of fat, and then by warm water to get rid of the soda. Finally, the whole apparatus from the receiver to the teat-cups should be taken apart; the receiver, "claw" and metal parts of the cups cleansed or sterilised by steam or boiling water; and the rubber tubes and linings should be kept in the brine and lime solution until the next milking, when they should be rinsed before using. The salt bath has no injurious action on the rubber, and in fact acts as a preservative.

These operations naturally take time, but such cleansing is necessary to ensure that the milk obtained shall be of good quality. Provided that every care is taken in cleansing the machine, and that cotton filters are used for the air reliefs in those machines in which they exist, milk of a very high grade may be obtained, comparable with that produced under the best conditions by hand.

Having given these directions, Dr. Orr offers a comforting pendant to the gruesome picture with which he illustrated the necessity of cleanliness. In 1906 Erf, in a series of 12 experiments, found a bacterial content of 8,700 per cubic centimetre in hand-drawn milk and 2,200 per cubic centimetre in machine-drawn milk—both produced under the best conditions. Stocking and Mason (1907), in a similar experiment, obtained the following figures:—Hand-drawn, 4,560; machine-drawn, 1,578.

Other reassuring figures are quoted, closing with those of Hooper and Nutter who, in 1914, examined 220 machine-drawn samples from a private farm, which averaged as low as 4,624 bacteria per cubic centimetre, only 14 samples exceeding the certified limit of 10,000.

Dr. Orr has certainly made out an excellent case for the necessity as well as for the possibility of cleanliness in milking machines.

* * * * *

AN experiment* made at the Welshpool County School for Boys to give an agricultural bias to the ordinary school teaching has aroused considerable interest in the schools of England and Wales, and important developments may take place. So important was this experiment deemed by the Board of Education that a grant was made to the School for the year 1913-14, and for the two subsequent years, in order to assist and encourage the work and also to test its effect on the general course of education. If the example of the Welshpool School is widely followed in the schools of Great Britain the results may be of far-reaching importance.

The Welshpool County School is situated on the rich alluvium of the Severn Valley, in the eastern portion of the county of Montgomery, and has an average of 100 students, of whom about half are farmers' sons. Efforts to give an agricultural trend to the teaching date from 1908, when the Agricultural Department of the University College of Wales, Aberystwyth, sent a member of its staff to give instruction, one day each week, consisting mainly of specially useful and applied points in agricultural chemistry, combined with farm visits for the observation of crops and farming operations. A school garden was laid out, arranged for practical and observational work, and planted with bush and fruit trees. These arrangements continued for two years, and will doubtless prove beneficial to the boys. In 1919 a master to take charge of the rural work of the school was added permanently to the staff; a Rural Room or Agricultural Laboratory was built; and half an acre of land adjoining the school was secured for outdoor work. It was considered that it was not the duty of a secondary school to give definite training in the technical and manual processes of agricultural practice,

*"Education in Wales: The experiment in rural secondary education at Welshpool County School for Boys—(Welsh Department, Board of Education, 1920. Price 2s. 6d. net).

and consequently, in adapting the school curriculum, only those parts of a physics syllabus were retained that were essential to a boy's general training and had definite application to agriculture. Botany and elementary Animal Biology were also introduced.

Only a brief outline of the plan of study can be given here. The science course in Form II (first year) consists of lessons in experimental science, which includes physics and chemistry; and nature study, comprising plant and animal life. In Form III (second year) the experimental science course deals with the factors bearing on soil temperature; the chemistry course includes experimental studies of air and water; and the botany class studies seeds, roots, stems and leaves; while the outdoor work includes pruning. The agricultural science class studies the soils and crops of the school district; the animal biology work deals with the structure and life history of insects, bird life, moles and voles, with their enemies the stoat and the weasel; and cultural work on the germination of seeds.

In Form IV the botany syllabus includes a study of the nutrition of plants, practical outdoor work on the vegetative reproduction of plants, and the raising of seeds of mangolds and swedes from the best representatives in the plot. Agricultural science work comprises a study of the physical properties of soils, the effects of the various tillage operations on the soil, plant food, manures, types of farm crops, and the composition of milk. Collections of local soils and subsoils are made, and culture work in plots is carried out.

Form V (fourth year) chemistry includes a study of sulphur and nitrogen compounds, and the manufacture of nitrate of lime and its use as a fertiliser. The agricultural botany work deals with seeds of grasses and clovers; the fungi causing various diseases are investigated and methods of prevention and treatment shown. In the outdoor work, the spraying of potatoes and fruit trees is undertaken, and at the invitation of the local Food Production Committee the school has organised the spraying of potatoes in the district. Agricultural science work deals with the manufacture and composition of manures, soil improvement, crops and their relation to the soil in which they grow, as well as the chemical changes occurring in plants, feeding stuffs, nutrition of animals and plants, farmyard manure, chemistry of the dairy, and cultural work in plots.

In addition to the general science scheme outlined above, other subjects of school study are given a rural application. Arith-

metic includes problems dealing with farming practice, such as the measurement of stacks, areas of fields, and valuation of manures from the percentages of composition. Later, it is hoped to introduce a section dealing with the mechanical principles underlying the construction and working of farm implements and machines. In geography, the school district forms the first area of general study, and the boys are instructed in the use of Ordnance maps. Rainfall, barometer and thermometer readings are taken in connection with the School Meteorological Station, and the relation between the climate of the neighbourhood and local farming operations is noted. Efforts are made to stimulate interest in woodwork by the construction of models that are of direct agricultural interest, such as nesting boxes and beehive frames. A rural trend is also given to such subjects as drawing, English literature, history (including the history of agriculture), Welsh and Latin.

The school garden is well stocked, and is especially useful for the practical study of insect pests and measures of control. The students take part in the operation of planting, and are taught the operations of pruning, grafting and budding of fruit trees. Numerous experiments are carried out, some of which are designed to illustrate the effects of various fertilisers on different crops, while others show the results of sowing seeds at various times and at different depths. The remainder have reference to such subjects as continuous cropping and a comparison of varieties of potatoes with regard to crop production and immunity from disease. Practical studies are made of mangolds, sugar beet, parsnips, carrots, swedes, turnips, oats, barley and rye, all of which are grown in the school plot. Records of all experiments are kept by the students, who are allowed to enter the plot at any time for the purpose of making observations. The Ministry's leaflets are extensively used.

Farm outdoor work includes seasonal visits to the Home Farm (1,200 acres) of the Earl of Powis, thus providing opportunities of observing methods of cultivation, varieties of stock and implements. A report is prepared by the students and is published in the local press each year on the results of the plot experiments that are of particular interest to local farmers. Nearly all the operations in the cultivation of the school garden and plot are performed, under direction, by the boys themselves, as it is considered that, if the students were mere spectators, their interest would be only partial and the educational benefit lessened.

Apart from its general educational value, the scheme of rural science work is believed to be specially suitable for boys who hope to proceed to a University College with a view to taking a degree in agricultural science subjects. Although they will have received no instruction in technical farm processes, they have obtained a fair insight into those sciences that are basal to agriculture or indirectly bear on the industry. Agricultural scholarships, tenable at a University College, provide a stimulus for further education in the case of students who look to the land for their career. It is the experience of the school that many boys who intend to take up farming at home leave school at the end of their third year, at the age of 15 or 16. These boys will have done work specially arranged for them on the school plot, and are exactly the type for whom the more technical instruction of a Farm School or Institute or the University College short courses in agriculture would be suitable. Many are already receiving County Council grants for this purpose.

The introduction of a rural trend in the various subjects has not, it is believed, interfered in the least with the success—examinational or intrinsic—of pupils of the more academic type. On the contrary, it has contributed to the basis of a good general education, and has tended to make the students more alert, giving them a wider outlook.

It is felt that one effect of training on the lines indicated will be to give to the pupils, and through them to their parents and a wider public, a fuller realisation of the economic importance of the land—the nation's greatest asset—and a deeper interest in the countryside. Agriculture is the basal and most vital industry of this or any other nation, and is a fascinating subject of study. There is something in the touch of Mother Earth that makes for joy and health and life.

* * * * *

In view of the necessity for exercising the greatest economy in the use of sugar at the present time, and the desirability of conserving the largest possible amount of **Jam-making when** fruit, the following information, contained **Sugar is Scarce.** in Leaflet No. 354, issued by the Ministry, is here reprinted:—

. With the present price and short supply, it is necessary to economise considerably in the amount of sugar used for making jam. ~~Glucose~~ can be thoroughly recommended as a sugar

substitute when used in the proportion suggested below, because :—

- (a) It is cheaper.
- (b) It will yield an equivalent weight in jam.
- (c) It will reduce the tendency of jams to crystallize (sugar-coat).

The best kind of glucose for jam-making is in syrup form and is known as Corn Syrup or Corn Sugar. Glucose chips do not yield such satisfactory results as glucose syrup, and are not recommended.

Selecting and Preparing the Fruit.—See that the fruit to be used is in clean and sound condition. Do not use over-ripe fruit; it is better that it should be slightly under-ripe. Wash well in cold water, with the exception of soft fruits, like raspberries, strawberries, &c.; these would lose a great deal of flavour if so treated. Preparation of fruit varies somewhat according to the kind; e.g., gooseberries should be topped and tailed, currants lightly shredded from their stalks, rhubarb skinned and cut into pieces of a uniform size, and the hulls should be removed from raspberries.

Jam-making with Glucose and Sugar.—Glucose cannot be used alone as a substitute for sugar. It should only be used with sugar and then only up to the proportion of one-third of the quantity of the latter. The combined quantity of sugar and glucose should be equal to that of fruit when under-ripe fruit is used. With ripe fruit, the quantity of glucose should be slightly less.

Put the fruit into a preserving pan and add just sufficient water to break down the texture when the fruit becomes heated; ripe fruit requires less water than green fruit. Add the sugar, and stir until completely dissolved. Add the glucose (Corn Syrup) after the sugar crystals have all been dissolved. Boil rapidly, stirring briskly to prevent burning. The point at which boiling may be stopped can be ascertained by testing a little of the jam on a cold plate; if there is no sign of its becoming firm on cooling, keep on the boil until a "set" is obtained. Over-boiled jam is usually too stiff and solid, and consequently is not so appetising as when correctly boiled.

When poured into jars the jam should be covered as soon as it is cold either with waxed paper or a thin sheet of paper dipped in brandy or other spirit. The jars should then be tied down tightly with parchment paper and stored in a cool dry place.

Points to watch to avoid Failure.

1. *Over-ripe* fruit makes jam of poor consistency. It must be boiled longer and thus to a less weight. Jam made from it is therefore more expensive.
2. When using glucose, add it after the sugar has dissolved. Glucose has a tendency to burn if added too soon.
3. Do not use more than one-third glucose to the weight of sugar. Ripe fruit must not have as much glucose in proportion to sugar, *i.e.*, use less than one-third.
4. Ripe fruit requires slightly less sugar, *i.e.*, if using 6 lb. of very ripe fruit use 5 lb. of sugar and glucose.
5. The pan should be not more than half-full when all the ingredients are added; this allows for rapid boiling.
6. *Boil quickly; do not simmer.* Correct boiling will produce slightly less jam in weight than the total of fruit and sugar together put in.
7. Allow the jam to *cool down thoroughly* before placing covers on jars.

Suggested Recipes.

Gooseberry Jam, with sugar and glucose :—

8 lb. green gooseberries.

Little water (to break down texture).

6 lb. sugar.

2 lb. glucose.

Weight when finished—approximately 14½ lb.

Plum Jam, with sugar and glucose :—

8 lb. under-ripe plums (Pershire (egg) plums are the best for this purpose).

Little water (to break down texture).

6 lb. sugar.

2 lb. glucose.

Weight when finished—approximately 12½ lb.

With ripe fruit use 1½ lb. of glucose and 6 lb. sugar. If no glucose is used the weight of sugar when added should be approximately equal to that of the fruit.

* * * * *

SHORTAGE of grass can be made good in several ways, and farmers anxious to increase their stock of winter fodder will sometimes find a fair amount of autumn keep in maiden seeds. These, however, must be grazed with great care if the future of the crop is not to be endangered. After a covering crop has

**Substitutes
for Hay.**

been harvested, the seeds should be rolled, to effect consolidation and to promote tillering. Before being depastured the plant should be allowed to establish a firm and fairly deep root-hold as a protection against winter frosts, spring drought and the risk of being uprooted by stock. Grazing is useful in the cases of such short-lived plants as Red Clover which, if allowed to reach or even approach maturity in its first autumn, will perish to a large extent before spring. Grazing will check this, and also reduce the risk of "clover sickness" and encourage the branching of such grasses as may have been included in the seeds' mixture.

For winter feeding, hay may be wholly or partially replaced by the straw of oats, barley and wheat. The riper the straw becomes the tougher it is to chew. While barley should not be cut until it is dead ripe, oats and wheat may, with advantage, be harvested a little before that stage is reached. In general, spring-sown cereals are less fibrous than winter-sown, and are consequently more nutritious. For fodder, oat-straw is preferred, but barley-straw containing a proportion of grass and clover is also useful. Cereal straw is relatively rich in carbohydrates and uniformly poor in albuminoids; consequently the proportion of albuminoids must be increased in the ration. This can be done by the addition of cakes or meals. Straw for fodder is best chaffed and mixed with slices or pulped roots, crushed cake or meal and treacle water, and allowed to stand overnight. A slight fermentation ensues, softening the straw and further adding to the palatability of the mixture. In order to save straw for fodder, more bracken and peat moss should be used as litter.

Bare pastures may be supplemented by vetches, maize, cabbages, early turnips and mangold roots, but where these are scarce, potato tops may be found useful. These should be cut just after they begin to turn yellow, and should be fed on grass-land, but *not* on grass which is to be broken up for potatoes next year, as this might cause disease to be transmitted. Green tops should be sparingly used, those dried in the sun and wind being preferred. Tops bearing many blossoms or unripe fruits should be avoided. They should be as free from earth as possible and be fed in small quantities. White mustard, provided that it can be sown by the end of August, is another substitute which may be broadcasted among stubbles. If not required for sheep-feeding the crop may with advantage be ploughed in as green manure.

Formerly, gorse or furze was used in this country as food for stock, and was even specially cultivated for that purpose. It is of two types—the ordinary prickly gorse, and the French or fox-tail gorse, which is relatively free from spikes. The latter is to be preferred, but ordinary gorse, if thoroughly pulverised, may be fed to stock with good results. Gorse for fodder is usually crushed between rollers. It should not be allowed to lie long in bulk as it ferments and becomes sour and unpalatable. In the case of old-established gorse only the green tops are fit for feeding. Old gorse coverts, however, may be reclaimed by cutting down the woody plant as close to the ground as possible and dividing the roots freely. In from one to two years the subsequent young growth will be ready to cut. Gorse is highly nutritious and has proved satisfactory with all classes of farm live stock, especially with horses and milch cows. It should form only one part of the ration, as when fed to excess it proves too heating, an effect which may be counteracted by giving an occasional bran mash or a daily allowance of roots. Up to 20 lb. per head daily is a safe ration for horses and cows. In the Woburn experiment in gorse cultivation the crop was put through a gorse cutter and fed to sheep with swedes. The sheep ate readily up to 2½ lb. per head per day of fresh gorse, and thrived well upon it. Gorse-studded areas provide a useful winter range for young horses.

* * * * *

THE fact that this country has in the past ten years paid an average of nearly £8,000,000 a year to foreign and colonial countries for poultry and eggs, and in 1919 paid rather more than £10,000,000, indicates that there is an enormous demand for these

Improvement in Poultry Keeping

products and that our own producers are unable to satisfy it. The number of poultry kept per head of the population is stated to be far below the figure for the United States, and the reason for this doubtless is that our farmers do not yet fully realise that there is money in poultry keeping. Research is certainly necessary to inform us as to feeding, breeding, laying capacity, and diseases, but education is also necessary to convince our people of the desirability and practical value of poultry keeping, and to keep them informed how birds should be managed to ensure the best results.

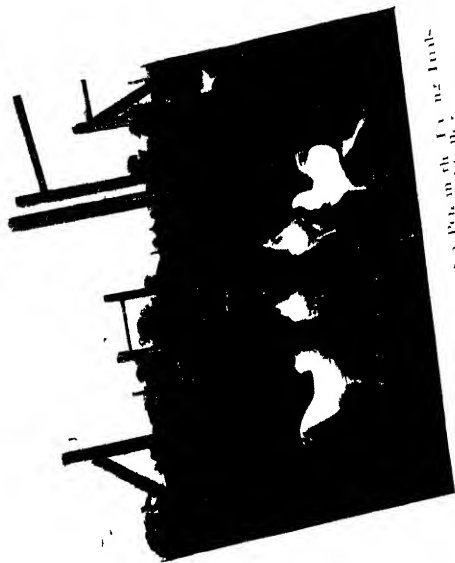
At the fourth annual poultry conference, held at the Harper Adams Agricultural College, Newport, Salop, from 10th to 12th August, and presided over by Principal P. H. Foulkes, many



Poultry Houses exhibited at the Harper Adams Poultry Conference



General View of Egg-Laying Trial Pens at the Harper Adams
Agricultural College.



White Le-bos. Part of a Pen in the F. V. H. Ind-
Hatch Adams Azores about 1902



Light Sussex. Part of a Pen in the Laying Trial- Harper
Adams Agricultural College

matters of importance to present or prospective poultry keepers were discussed, papers being read by outstanding authorities and followed by discussions, in which many of the most practical breeders in the country took part. In regard to laying trials, papers were read by Mr. Tom Barron on "The Value of Laying Trials"; by Rev. Lewis Jones on "Laying Trials as Viewed by a Breeder of Exhibition Stock"; and by Mr. W. J. Corbishly on "The Proper Basis of Valuation." Education and Research received very full consideration, papers being read by Mr. P. A. Francis (Ministry of Agriculture) on "Education in Poultry Keeping"; Mr. F. W. Parton (University of Leeds) on "The Universities and the Industry"; Mr. F. W. Rhodes (Lecturer at Harper Adams Agricultural College) on "Poultry Education for Ex-Service Men"; Mr. Edward Brown on "Poultry Education in America"; Professor Charnock Bradley (Principal, Royal (Dick) Veterinary College, Edinburgh), on "Research in Poultry Keeping," and by Mr. Tom Newman on "Research in Incubation."

The third day was devoted to papers on the commercial side of the subject, a paper being read by Mr. Oscar Brown on "Ducks as Egg Producers," while other papers discussed commercial egg farming, co-operation, transport facilities, the use of cement in constructing poultry houses, &c. A paper by Sir John Green on "Poultry as a Village Industry" was read for him owing to his unavoidable absence.

Medals and certificates were presented on behalf of the College by Sir Daniel Hall, F.R.S., who gave a short address on the importance of poultry keeping and the desirability of improvement in every direction.

The College laying trials were open for general inspection, and there was an interesting and useful exhibition of poultry houses and appliances and of typical utility stock (see photographs). The gathering of visitors was a large one, and it was felt generally that the conference proved a valuable means for the exchange of ideas.

* * * * *

THE following note has been communicated by Mr. R. R. Blewett, Headmaster of Lanlivery Council School (Cornwall Education Committee):—

**Poultry Keeping
in an Elementary
School in Cornwall.**

In the spring of 1920 a chicken feeding experiment was carried out by the upper class children and carefully supervised by the Headmaster of Lanlivery Council School.

The aims of the experiment were primarily educational, and the work involved training in :—

1. Rough woodwork—the sitting box and chicken coop being made from cheap packing cases by the boys who take the course in rough woodwork.

2. The care and treatment of young live stock and close observation of the development of plumage.

3. Weighing and measuring, and arithmetical calculations in fractions, decimals, and percentages.

Every pupil was provided with a sheet of foolscap, which was kept throughout the whole course of the experiment and on which was recorded, in two tables previously ruled, the weight of the flock at weekly stages, and the weekly weights of foods consumed, with valuations. On the completion of the experiment the results were summarised, and the summaries, with a balance sheet, were distributed among the parents of the scholars.

Each week's work concluded on Thursday night. Friday morning's arithmetic lesson was devoted to calculations based on the week's consumption of food and the weight of the chickens. Food remaining in the " 7-lb. " bags was weighed, recorded and subtracted from the last week's remainders, the difference giving the weight of the food consumed for the week. This was followed by valuations in exact fractions of a penny, calculations in the fraction and percentage of increase in the weight of the chickens, and the total weights and values of foods which went to make that increase. The fact that the objects of the mathematical discussions were running about outside the School made the subject a living interest to the scholars.

Although the aim of the experiment was educational, the figures obtained cannot fail to interest small producers of table poultry. Eleven cross-bred chickens (Indian Game crossed with Golden Wyandotte) were hatched on 4th March, and sold on 20th May, when eleven weeks old, for a total sum of £3 6s. At the time of selling they weighed 28 lb. 14 oz. (average 2 lb. 10 oz.) live weight. The total cost of production was £1 10s. 10½d., made up as follows :—market price of the eggs, 4s. 4½d. ; food for mother hen for nine weeks, 2s. ; food consumed by the chickens, £1 4s. 6d. The excess of income over expenditure was £1 15s. 1½d.—an average of 8s. 2d. for each bird.

Of the eleven chickens, only three were cockerels, and at the date of sale, after a twelve hours' fast, these weighed 8 lb. 3 oz., 3 lb. 0½ oz., and 8 lb. respectively. With the exception of a

few hours before each early morning meal, the crops of the birds were never empty, from the first meal given 24 hours after hatching until the last meal early in the day on which they were sold. From the second week these birds acquired the habit of "over eating." They were, therefore, never very active, and although they had free range were living under what was practically fattening pen conditions.

The following foods were used:—biscuit meal (chicken grade) at 6d. per lb.; flake oatmeal at 6½d. per lb.; dry chick feed (consisting of broken maize, wheat, peas and rice, hemp seed, dari, &c.) at 7 lb. for 2s. 6d.; granulated meat at 6d. per lb.; wheat at 24s. per cwt. (damaged); maize at 80 lb. for 6s. 6d. All these were bought in small quantities, the highest prices being paid.

During the first week the average cost of feeding was very slightly under 1d. per bird per week. By the fourth week it had risen to nearly 2½d. per bird, and kept roughly to this figure until the seventh week, when it mounted to slightly over 3d. per bird. This average remained fairly constant to the end of the experiment, except that on the tenth week the reintroduction of biscuit meal and granulated meat into the diet raised the average cost to nearly 4½d.

One of the problems each week was to ascertain the cost of producing 1 lb. live weight of chicken during the week. At the end of the first week, after reckoning the cost of the eggs for hatching, the food of the mother hen and chicks, the cost of producing 1 lb. live weight was 9s. 10d. By the end of the second week it had fallen to 2s. 11½d.; the third week to 2s. 3½d.; and the fourth to 1s. 11d. By the sixth week the cost had dropped to 1s. 5d. It then fell by slight stages each week until, by the date of sale, the cost of producing 1 lb. live weight was 1s. 0½d. The birds when sold realised 2s. 3½d. per lb. live weight.

For each of the first four weeks the birds put on an increase of 50 to 60 per cent. on their previous week's weight. In the fifth and sixth week this percentage of increase dropped to 40 per cent. In the seventh week the increase was 27 per cent.; on the tenth it had fallen to 23 per cent. During the first week the cost of putting on 1 lb. live weight was at the rate of 1s. 9d.; and after ten weeks the figure was 9½d., but during this period feeding was more costly. In the ninth week, when only wheat and maize were fed, the cost of putting on 1 lb. live weight was as low as 6½d. It follows that the "finishing" is a much cheaper process than the production of a 2 lb. bird.

The feeding and the results attained in the eighth and ninth

weeks are interesting. In the eighth week 12½ lb. of wheat only were consumed. At the end of the week the birds showed an increase in weight of 3½ lb., or 23 per cent. In the ninth week the food consumed was 6 lb. of wheat and 7 lb. of maize. This produced an increase of 5 lb., or 29 per cent., in the weight of the birds in spite of the fact that the percentage of increase had been falling since the fourth week. This would seem clearly to point to the value of change of food.

Not the least important side of the experiment was the interest it aroused in the immediate neighbourhood.

* * * * *

THE following note has been communicated to the Ministry by Miss Grace Heather Mason, Lecturer in Agricultural Bacteriology at University College, Reading:—

Pink Discoloration of Cheese.

An investigation has recently been made in the University College, Reading, with a view to ascertaining the cause of pink discoloration of cheese forwarded for examination from a dairy in Yorkshire. The complaint was that the cheese, although normal in appearance when first cut, developed a pink colour very shortly after cutting, the colour spreading over all the cut surfaces, and shading in tone from a light salmon or rose pink to a violet purple. The cheeses were of small size, weighing from 4 lb. to 7 lb., and were made on the Wensleydale system.

It appeared that the affected cheeses had been made during a period of ten days in the summer, and that the coloration was first observed when the cheeses were a month old. The dairy maid who made the cheeses was inclined to believe that the pink coloration was due to the rennet used, the supply of which was obtained from a local chemist, and only lasted during the period these particular cheeses were made. It was not, however, possible to obtain a sample of this particular rennet for this view to be confirmed.

An examination of the affected cheeses showed that freshly cut or broken surfaces were normal in colour at first, but became pink within 12 hours, the colour appearing along the course of fine cracks and veins in the cheese, following the lines of junction of individual pieces of curd. The cheese being of a lightly pressed, spongy texture, this coloration spread rapidly over the surface, leaving the denser portions of curd uncoloured, this giving a marbled or mottled appearance to the cheese. The colour was very marked, and was of a darker pink or violet

tint just under the coat of the cheese. It only penetrated to a depth of about 0.5 mm., so that successive thin layers of tinted portions could be sliced off, leaving a white surface, which in turn became coloured after exposure for a few hours.

Examination of the Cheese.—Examination made of small portions of the coloured cheese showed that large numbers of yeast cells of various shapes, as well as bacteria, were present. Portions of the cheese, both coloured and uncoloured, were then subjected to gelatine and agar, and whey agar tests. It was found that colonies of the usual cheese bacteria of the lactic-acid group, and others, appeared, as well as colonies of yeasts and torula. The yeast was isolated, and grown in liquids and on solid media, in all of which it grew and produced colours of various shades of rose, pink and salmon, the colour deepening as the culture became older.

Trials with the yeast were also made on three small cheeses, weighing from 1-2 lb. each. One cheese (No. 1) was made from milk which was inoculated just before renneting with ground-up portions of the original cheese sent from Yorkshire, and the two other cheeses (Nos. 2 and 3) were made from milk which was inoculated with the pure culture of the pink yeast.

No. 1 cheese was made on the Cheddar system, a lactic acid starter being used, and just before renneting a quantity of the original cheese, grated up and mixed with sterilized whey, was added to the milk. The high scald (102°F.) was used as in Cheddar practice. Cheese No. 2 was made in the same manner, except that, instead of the ground-up cheese, a pure culture of the pink yeast grown on bread was added to the milk before renneting.

The cheeses all ripened normally, and were examined daily and cut at about 8 weeks old. In Nos. 1 and 2 no growth of the yeast or pink coloration was noticed, the cheese being somewhat dry and very firm in texture. It was concluded that the dryness and texture and the high scald of the curd had resulted in conditions unsuitable for the growth of the yeast.

On the coat of No. 3 cheese, which was made with a lower scald, resulting in a softer curd, small spots and patches of pink and violet were observed at a very early stage. These followed the cracks and openings in the coat, and even in some places penetrated a short distance into the curd. As the cheese became firmer and dryer, these spots did not spread rapidly, but remained confined to the coat on the clothing of the cheese.

Another cheese, about 2 lb. in weight, was then made on the method of the original cheese more closely. No lactic acid starter was used, and the curd was not scalded above 88°F. The pure culture of the pink yeast in whey was added as usual. The curd was put up loosely, and only very light pressure was applied.

Spots of pink very soon appeared on the outside of the cheese just under the muslin in which it was covered, and were found to contain the yeast cells.

The colour on the coat spread gradually, and turned to a rusty tint. When the cheese was cut at about a month old, the pink colour developed slowly over the cut surface, following the veins and cracks between pieces of curd as in the original sample.

The consistency of the cheese was spongy, open, and not of a satisfactory character from a cheese-maker's point of view, and in this it resembled the original cheeses.

No positive conclusions can be drawn from the experiment, but it would seem that the coloration was due to the yeast.

* * * * *

A VERY good case can be made out for the cultivation of tobacco on English soil. Recent research and experiment has shown that tobacco cultivation is worth developing. It is said that if 1,000 acres of British soil, unsuitable for the production of wheat, were put under tobacco, the industry would provide profitable employment for 200 families during at least eight months of the year, and would benefit both employer and employee.

Tobacco Growing in England.

Tobacco-growing in this country was begun soon after the plant was first brought from America. It was introduced from Florida, probably in 1565, by Sir John Hawkins, although this gift to the eastern hemisphere is more usually associated with the name of Sir Walter Raleigh. To him its introduction is attributed by Edmund Howes, the chronicler, who says that "Sir Walter Raleigh was the first that brought tobacco into use when all men wondered what it meant." According to John Worledge in his "Systema Agriculturæ" of 1675, there were plantations of many hundreds of acres of tobacco in Gloucestershire, Devonshire, Somersetshire and Oxfordshire. Worledge describes the processes of growing and preparation. "The young plants," he says, "are raised from seed in February or March on a hot bed, and then planted out

in your prepared ground from whence you may expect a very good crop and sometimes two crops in a year. The leaves when gathered are first laid together on heaps for some time and then hanged up (by a thread run through them) in the shade until they are dry and then put up and kept, the longer the better. In this, experience is the best master." This considerable cultivation sufficiently proves the popularity which tobacco had attained during the century immediately following Hawkins's and Raleigh's time.

Notwithstanding its popularity, tobacco had incurred the censure of James I.; and is expressed in his famous "Counterblast to Tobacco." His dislike was shared by Cromwell, who sent troops to tread down the fields, but the Parliamentary soldiers are said to have smoked at the Protector's funeral in order to celebrate their recovered liberty. In Charles II.'s time tobacco flourished at Winchcombe in the Vale of Evesham, but rather than collect excise duty the authorities preferred to abolish the English growth. They were prompted also by certain courtiers who desired a monopoly in the Virginian plantations. Pepys records that it was necessary to send down troops to destroy the tobacco fields, and, as in Ireland at a later date, an industry was deliberately wiped out of existence. By this time it might have developed such proper varieties, methods of cultivation and manufacture as would give it a suitable position in the general market.

In 1831 the Act permitting tobacco to be grown in Scotland and Ireland was repealed, apparently on account of the difficulty of excise supervision. In 1886 and 1887, however, small trial plots were permitted in England, but the results were not encouraging. Tobacco cultivation in this country may be accounted practically non-existent since the early years of the 19th Century. An attempt made in 1883 to revive the industry failed, owing to incomplete knowledge of the best methods of managing the crop. Tobacco is a highly specialised plant requiring intensive and careful cultivation. The leaf intended for smoking must be very carefully blended. It is to be feared that the home industry has been prejudiced by popular distrust of British-grown tobacco, a prejudice that may have arisen from successive failures to establish cultivation in these islands.

In 1907 the Act of 1831 was repealed, and since that time it has been lawful to cultivate tobacco in Ireland. With regard to prices for British tobacco it is interesting to note

that, in 1626, eight ounces cost 5s. and in 1656 two ounces cost 1s. It would appear that in 1620 this country paid Spain £120,000 annually for tobacco. In 1907 the duty on tobacco containing not less than 10 per cent. of water was 3s. per lb. Owing to an extension of the experiments in Ireland, the Chancellor of the Exchequer authorised a payment of 1s. per lb. to be refunded to the producer out of the duty paid on withdrawal from bond. The tobacco on which this rebate could be claimed was limited to the produce of 50 acres. In 1908 the Chancellor of the Exchequer financed a five years' experiment costing £6,000 a year, and this experiment was continued with Treasury assistance on the recommendation of the Development Commission.

The Finance Act of 1909-1910 removed, as far as England was concerned, the ban upon tobacco cultivation, but in 1913 the rebate was withdrawn, and during the Great War the duty gradually rose to 8s. 2d. In 1919 the present Chancellor of the Exchequer gave one-sixth of the duty to Empire production, and a further 2d. excise allowance to the English product.

In 1911 Mr A. V. Campbell of the Rothamsted Laboratory visited the tobacco-growing centres of Ireland, Holland, Belgium, Germany, France and the United States. His Report confirmed the opinion of the Development Commissioners that the question which requires settlement is not whether saleable tobacco can be grown here, but whether it can be grown at a profit. The Report states that an experiment should not be limited to one district and one kind of soil, but should be made on a fairly large scale, because economic cultivation cannot be carried out on less than 100 acres. Now that tobacco-growing in England has passed the experimental stage, trustworthy data are available as to the best districts, soil, plants to raise, manuring, and methods of curing. The British Tobacco Growers' Society has carried out experiments in many parts of England and has proved that the crop can be grown successfully on the poorer soils of Norfolk, and that this plant can take its place as a farm crop in the ordinary rotation. The Norfolk crops are looking well, and 36 acres are well established in the district of which the Ministry's estate at Methwold is the centre. At Fleet in Hampshire 20 acres are being cultivated.

Potash Supplies. DURING the 1919-20 season a considerable quantity of high-grade potash salts was imported from Germany by the Government in exchange for food supplied in the spring of 1919. Alsatian potash was also imported on private account under licence on a large scale. There are now no longer any import restrictions, and merchants are free to import potash without licence from either Germany or Alsace. As the Government is making no official arrangements for its importation from either country, farmers will have to rely for their supplies on the efforts of private firms, and the best way to ensure that they will obtain them is to place their orders early with their usual merchant or co-operative society in order that these may pass on their orders in good time to the importers. Sylvinite, 14-16 per cent. (French kainit), 20-22 and 30-32 per cent. (French potash manure salts), and muriate of potash, can be obtained from Alsace; and 12 per cent. kainit, 20 per cent. and 30 per cent. potash salts, and muriate and sulphate of potash from Germany.

* * * * *

**Milk Recording Societies:
An Interesting Competition.** THE development of Milk Recording Societies affords one of the most promising aspects of the agricultural situation. Not only are these Societies doing very good work to improve the quantity and quality of milk and to weed out unthrifty animals in the dairy herd, but they are now beginning to sit up and take notice of their neighbours. They are coming very rightly to the conclusion that they either are or must be better than those neighbours, and in order to put the question of superiority to a test they are establishing dairy herds competitions. Such a competition, open to members of Milk Recording Societies operating under the Ministry of Agriculture in the counties of Surrey, Sussex and Kent, has recently been instituted in connection with the Agricultural Show at Tunbridge Wells. The authorities provided two special classes, and the Committee were fortunate enough to obtain the services as judges of Mr. A. F. Chillingworth and Mr. Robert Hobbs. These gentlemen in the course of their duties were compelled to travel some twelve hundred miles, for there were upwards of one hundred entries, divided into two classes (1) herds of twenty-five cows and under, and (2) herds of twenty-six cows and over. In all, the judges inspected one hundred and one herds. They report that not only was the standard of dairy cattle satisfactory but that they were pleased

to note the number of excellent bulls in use—many of them being full pedigree animals—while inferior stock bulls were quite an exception. The judges very wisely set their faces against herds in which, feeding and attendance being given without regard to cost, milk yields were not produced on an economic basis. They stated definitely that anything like Show condition of cattle should be discouraged. In Class 1 the prize went to a small herd of pedigree dairy Shorthorns, including three or four good non-pedigree foundation cows—the score being 92 points out of a possible 100. In Class 2 the prize went to pedigree Friesians with a score of 96 points; the judges remarked that the cattle were almost entirely home bred, and that the breeding, feeding and general management of the herd testified to the remarkable skill and ability of the owner. The daily average per cow worked out at 8.75 gallons, but out of a herd of 28 cows, of which five were dry, fifteen were milked three times a day.

Mr. H.E. Rudd, Live Stock Officer to the Ministry of Agriculture for the South Eastern Province, was largely responsible for this competition. It may be remarked that the growth of Milk Recording Societies in this area is very satisfactory, the four Societies established having more than doubled their membership during the past year, while there are many applications from prospective members for the next season, which opens on 1st October. It is hoped that there will be another competition next year in connection with the Show at Tunbridge Wells, and that, in addition to another herd competition of the kind just concluded, there will be special classes for individual cows, bulls and calves, open to members of Milk Recording Societies.

* * * * *

At a meeting of the Agricultural Wages Board on 12th August (Mr. Collingwood Hope, K.C., C.B.E., presiding), a report was

Agricultural Wages Board.

presented from the Administration Committee dealing with the issue of Permits of Exemption by District Wages Committees, the steps taken to secure the enforcement of the Board's Orders since the last meeting of the Board, and the results of the proceedings in six cases of prosecution which had been undertaken since that meeting.

The Board adopted a report presented by Mr. Acland from the Committee on "Cottages," recommending, *inter alia*, the confirmation of determinations by various District Wages Committees of 21 cottages as defective, under the terms of the Board's "Benefits and Advantages" Order, and of the deduc-

tions which the District Committees had made in the cases of the cottages in question from the maximum value at which a cottage may be reckoned in part payment of minimum rates of

The Board considered the objections received to their Proposal of the 9th July, to increase the minimum rates of wages for male agricultural workers of 21 years of age and over throughout England and Wales, together with the reports on the Proposal made by the various District Wages Committees. With certain minor amendments, the Proposal was confirmed as an Order, to come into operation on Monday, the 23rd August. The general effect of the Order is to increase the minimum rates of wages for adult male workers by 4s. per week throughout the country, with the result that the minimum rates for such workers will be 46s. in 19 of the District Wages Committee areas, and will range in the other 20 areas from 46s. 6d. up to 50s. 6d. in the case of Northumberland and Durham. The Order also provides for proportionate increases in the overtime rates.

A motion which was put by Mrs Toon for the revision of minimum rates for male workers under 21 years of age and for female workers of all ages, was referred to a Special Committee of the Board for consideration.

Full particulars of all Orders made by the Agricultural Wages Board are published in the *Wages Board Gazette*, the yearly subscription for which is 8s. Subscriptions should be sent to the Secretary, Agricultural Wages Board, 80, Pall Mall, London, S.W.1.

* * * * *

In a note published in the issue of the *Wages Board Gazette* for 2nd August it is stated that during July conferences have

Harvest Wages. taken place in several counties between representatives of employers and employed on the subject of harvest wages. In some counties a satisfactory agreement has been reached, generally embodying a slight increase over last year's rates, but in other cases nothing has been settled. The contention of the employers has generally been that the rate of wages fixed by the Agricultural Wages Board is meant to provide a living wage for the whole year and that as harvest operations are not under present conditions specially onerous no extra remuneration is required. The workers have replied that the minimum rate is insufficient and that harvest wages have always been recognised as part of the yearly income. As in former years, the claim arises chiefly,

but not invariably, in the counties where there is a large proportion of arable land.

(1) *East Sussex and Kent.* No further outbreaks of the disease were confirmed in this area after those referred to in the August "Journal," p. 420, and the remaining restrictions on the movement of animals were finally withdrawn on the 30th July.

**Foot-and-Mouth
Disease.**

(2) *Norfolk.* The restrictions on the movement of animals in the area scheduled on account of the outbreaks in the neighbourhood of Bowthorpe were withdrawn on the 27th July, no further cases having occurred in that area. Further cases have, however, been confirmed in the Emneth district, bringing the total for the series of outbreaks in Norfolk up to 25. The last case was confirmed on the 18th August at Pentney. All the most recent cases have occurred in a small area lying between Kings Lynn and Swaffham, which is the only part of the country now remaining under restrictions.

THE MODERN COTTAGE: EXPERIMENTS IN PISÉ AT AMESBURY.

Clough Williams-Ellis.

CLOSE to the station of Amesbury, on the edge of Salisbury Plain, there is a new hamlet. A year ago the spot was marked with only a few unsubstantial and unlovely shacks and bungalows strung out along the main road, constructions of wood and corrugated iron, the unhome-like homes of small freeholders, poultry farmers and the like.

The Ministry's new ownership of an adjoining 1,000 acres as a Land Settlement Estate for ex-service men, which was ill provided with cottages, at once imposed an obligation to build, and also gave an opportunity for a lead to other progressive landowners in the crucial matter of cottage building. That this opportunity was seized with considerable imagination and energy is well shown by the very interesting little colony that has been brought into being.

Anyone can build cottages—of a sort, and at a price. It was the Ministry's aim to demonstrate two things: (1) that cottages might be substantially erected by the use of local materials and by methods other than those commonly employed; (2) that the most severely practical buildings may be architecturally seemly.

Both of these objects have been attained. The common-sense "workability" of the cottages can be seen from the plans, while a glance at the accompanying illustrations will show that the Ministry's architects have observed the sane traditions of English cottage building. So far as can be ascertained, the current cost of pisé building is but little less than for brickwork, but it was hoped that in these operations pisé would prove considerably cheaper. This hope was not realised, however, as much of the wall building was done in the winter, and, as the work at Amesbury has proved, pisé work must be done in dry weather. If the earth becomes wet "ramming" cannot be carried out properly. At Amesbury the pisé walls had to be covered during wet weather, and as a result labour was wasted and time lost. It is important to lay emphasis on the fact that dry weather is needed for pisé operations to be satisfactorily performed.

It was decided that for the purpose of experiment, and in

order that comparison with other materials could be made, a series of cottages should be erected as follows:—

In Concrete (various systems)	...	...	...	4 cottages
" Cob	...	...	...	2 "
" Pisé de terre	...	...	...	6 "
" Timber (converted Army Huts)	...	...	...	2 "
" Timber (two-storied elm weatherboarded)	...	...	...	2 "
and the remainder in brickwork.				

This has been done, and the results are highly instructive to all who have watched the rise of "New Amesbury." The general lay out along a new road is simple, yet well conceived, although the experimental nature of many of the individual houses has necessitated a greater variety of types than is desirable in any ordinary village scheme.

The Department of Industrial and Scientific Research was responsible for the general character of five of the cottages, and in some of the cottages the experimental work has not been restricted to materials and methods, but has also invaded the province of pure architecture. The flat-roofed and box-like "all concrete" house is, for instance, something of an architectural adventure, though its claims to serious consideration from a rural housing point of view have yet to be justified. Of all the cottages, however, the greatest general interest is shown in those built of pisé de terre (earth rammed between movable shutters arranged as a temporary mould).

In this country, pisé building is still regarded as a somewhat startling novelty, a daring innovation to be attempted only with extreme caution and under the most expert supervision. Proper care and direction are of course necessary in this as in every other method of building: the pisé soil must, for instance, have certain characteristics, and the pisé builder must obey certain simple rules of procedure. Though there may be some who claim to be "experts," there is still much to be learnt, and this can only be acquired in the school of experience by the method of trial and error.

So far as this country is concerned, the most experienced authorities on pisé are little in advance of the beginners. It is the united observation and experience of enterprising laymen, working under a variety of conditions, rather than the academic researches of the specialists, that is likely to produce a sound tradition of British pisé building.

Now that the way has been shown, first by Mr. St. Loe Strachey in the "Spectator" pisé cottage at Newlands Corner, and now by the Ministry's more ambitious undertaking at

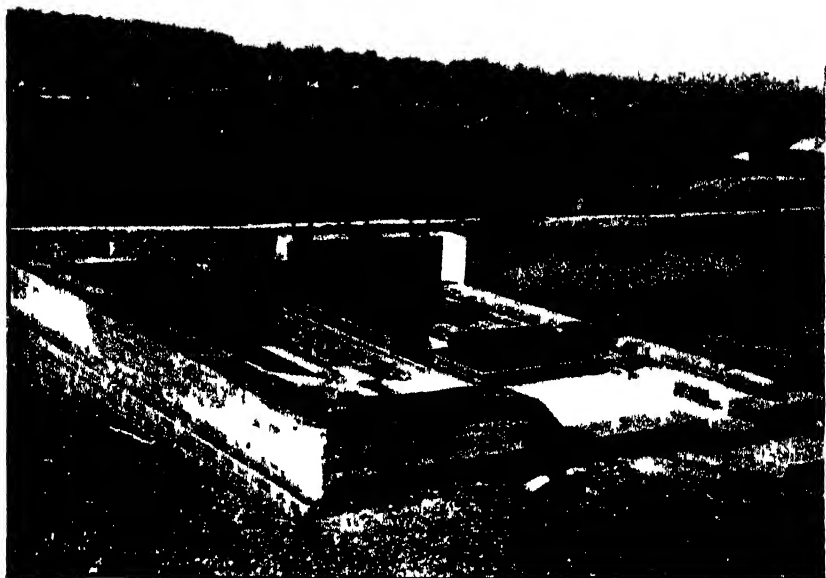


FIG. 1 Pisé de terre walls on brick base Shuttering in position on wall
(Author's pattern)

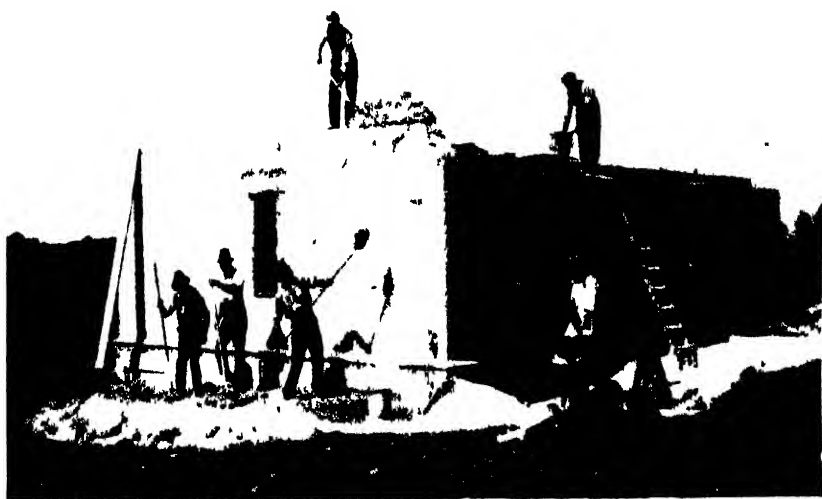


FIG. 2 Chalk Cob Chalk walling in process of erection Traditional method
Also showing concrete lintels cast *in situ*

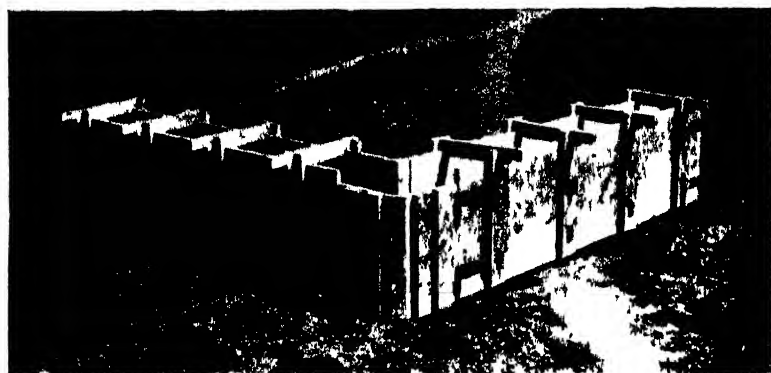


FIG. 3 —Detail of Standard Form for Composition Walling



FIG. 4 —Shuttering for pisé de terre, Ministry of Agriculture pattern



FIG. 5 — Cottage of Chalk and Cement (Diacrete) blocks — Walls in course of erection



FIG. 6 — Timber Cottages — View showing framing ready for weather boarding and roof tiling



FIG. 7—Chall Col Cottage—Corner of Living Room



FIG. 8—Amesbury—General view. Left to right—Cottage in Brick, Cottage of proprietary Concrete Blocks, pair of Cottages in Brick whitewashed, and pair of Cottages in Brick.

Amesbury, it is hoped that others will profit by the demonstrations. It is satisfactory that a large number of public bodies and private individuals are already engaged on pisé building, but there is still a paralysing tendency to say: "Leave the thing to other folk until we know more about it"—a policy not calculated to advance the system very fast or very far.

From very early beginnings in France, Spain and South America (there are walls in Mexico computed to be over 3,000 years old), but chiefly in the South of Europe, pisé building has spread slowly and sporadically, and numerous continental and transatlantic examples of pisé work exist of great age and excellence. It is strange indeed that the capabilities and merits of the system have remained for so long practically unknown in this country. The various soils and climates must affect its scope to some extent, but enough has already been done both in England and the Colonies to demonstrate the adaptability and wide applicability of pisé building.

Post-war scarcity and high prices have done much to bring the possibilities of pisé to favourable notice, not only in England but in Northern France, Belgium and even Sweden, where handbooks on pisé building have been recently published. The Ministry has also issued an interim report on "lessons learnt" at Amesbury, and the following notes extracted from the report contain some useful information on this method of building:—

"The conclusions derived from these investigations are set out briefly under the respective heads below. They should not be regarded as final or incapable of modification, for research can still be pursued in many directions; but the data already obtained are sufficiently definite for pisé construction to be embarked upon with satisfactory results.

- (A) *Soil*.—It is a mistake to suppose that all earths are suitable for pisé construction; preliminary tests should always be undertaken to determine the suitability of a soil before use. Samples of soil should be tested to ascertain their mechanical strength. The essential qualities of a soil for pisé work may be defined as a firm coherence of the constituent particles when rammed and dried, combined with an absence of excessive shrinkage in the process of drying. A pure clay would satisfy the former condition and pure sand or gravel the latter; yet neither by itself could possibly be used for pisé construction.

The earths ordinarily met with, however, are complex mixtures in which clay and sand are by no means the only constituents; and many of them possess the essential qualities owing to the presence of other ingredients in combination. Calcium carbonate, occurring in chalk, marl, or disintegrated limestone, helps to reduce shrinkage, while detracting little from the cementitious properties of the other ingredients present.

Organic components are bad, being particularly liable to shrinking in drying, and they weaken coherence in the earth as a whole. Top or vegetable soils are, therefore, generally unsuitable.

An all-important point is the amount of water present in the earth at the time of actual use. This factor is so dependent on the composition and character of the soil to be used that a statement of a percentage can only be taken as a very rough guide. In general it will be found that the water present should be between 7 per cent. and 14 per cent. of the weight of the dried earth. In illustration of this factor of water content it may be stated that a clay-gravel-sand mixture gave the best results with as much as 15 per cent. of water; while a chalk loam mixture with 13 per cent. of water shrank excessively on drying, but worked satisfactorily with 7 per cent. The tendency of inexperience is to work with too damp a soil. As long as the rammer will consolidate without pulverising the material it may be assumed to be wet enough. Should it "pug" under the rammer the earth is certainly too wet and will shrink and crack when drying out. A good average sample of the earth should be taken for testing, sufficient to make a number of test blocks; and each block should be made up at a different stage of the earth's drying, so that the most satisfactory water content may be determined by the tests.

The percentage of moisture is most easily found by weighing the samples as made, and again when they are quite dry; the difference in weight, taken as a percentage of the dry weight, giving the figure required. Exact measurements of the length of the sample should also be made, both at the time of consolidation and when dry. The percentage of shrinkage should in no case exceed $2\frac{1}{2}$ per cent. to 3 per cent., and can generally be kept under 2 per cent. when the water content is low.

- (B) *Shuttering*.—The shuttering required should be capable of resisting the considerable thrust of the ramming; ensuring a true face to the wall; be easily and speedily placed in position and moved as the work proceeds without support from the ground; and be economical in cost. The Ministry's technical officers have devised a set of shuttering rather different from that designed by Mr. Williams-Ellis and used for the Merrow Bungalow. This appears to meet the above requirements, has proved satisfactory in use, and is a pattern which has been adopted by many private owners who are beginning to build in pisé de terre.
- (C) *Best Form of Rammer*.—Iron, with a smooth surface, is a more satisfactory material for a rammer than wood. Two forms of rammer, each weighing about 7 lb., are desirable, one flat, the other shaped like a heart, tapering in thickness to the bottom, which should have a blunt edge.
- (D) *External Rendering*.—Various materials for rendering have been tried on pieces of experimental wall at Amesbury, but no definite



FIG. 9.—Cottage in Chalk Cob Completed Front View.



FIG. 10.—Cottage in Brick. Completed. Front View.

conclusions can yet be given in regard to them. As a result of the experiments it is proposed to try two forms of rendering on the cottages built, one of lime and sand, and the other of a proprietary bituminous material.

(E) *Building in the Winter.*—The cottage erected at Amesbury is proof that, given sufficient protection from severe weather, building in pisé can be carried on during the winter months. The expense of providing screens and tarpaulins, and the labour charges involved in moving them on and off the work as demanded by weather conditions, goes to prove, however, that it is not sound economy to undertake pisé construction during the winter season.

(F) *Cost in Comparison with Brickwork.*—The cost of the first pisé single two-storey cottage at Amesbury, when complete with all finishings and fittings, will not, it is estimated, show an appreciable saving over a similar cottage in brickwork. It must be remembered, however, that this cottage was the basis of all the experimental work; that the brick foundations were carried to an unnecessary height, as is now recognised; that there were difficulties and delays in arriving at a satisfactory form of shuttering; that further delay and expense were incurred by building in the winter; and that the workmen employed had to gain their practical experience on the work.

Work on the pair of two storey cottages in progress is proceeding smoothly now that the preliminary difficulties have been surmounted; and the careful costings kept in regard to all the building work show that pisé walls, using ordinary building labour, can be constructed at a cost of 15s. per yard super. as against 25s. per yard super. for 11-inch hollow brick walls. These figures are calculated on pisé walls 18 inches thick on lower floor and 14 inches above (average 16 inches), with labour at 1s. 3d. per hour producing 1 foot cube of finished wall per hour as against brickwork costing £56 13s. 4d. per rod. The cost of scaffolding is not taken into account in these figures, but would be less with pisé than brick.

The nature of the foundations is a considerable factor in the ultimate cost of pisé building. It is considered that the pisé work may be begun at 9 inches to 1 foot above ground level; below the level, brick, stone or concrete must be employed."

As regards soil, the material used at Amesbury was approximately a 2 to 1 chalk and earth mixture, both ingredients being immediately available on the site. The inconvenience of chalk is that it absorbs moisture, and unless this property is checked by the use of a good skin of some sort, trouble from frost is likely to be experienced. As, however, such buildings will ordinarily be completed and covered in before winter, the danger is more theoretical than real.

The Newlands Cottage had no more elaborate covering than a

coat of tallow lime-wash, and this has been found quite successful. If a previous application of hot tar (as used on roads) is given, the walls will have an almost impervious skin of quite surprising hardness.

It is interesting to note that in some of the Amesbury examples the chimney-flues are formed by clay pipes embedded in the surrounding pisé.

With regard to rammers and shuttering, there is, undoubtedly, still scope for improvement, and it may be hoped that soon ingenuity and experience will jointly produce a complete pisé-building plant perfectly adapted to suit all the many conditions involved. Some of the outfits recently made have been unduly elaborate and expensive, and, pending the introduction of a more suitable article, the Ministry has acted wisely in adhering to a simple "all-wood" construction that might well be made by any village wheelwright. This is modelled on the same principle as the gear described by Pliny, and is not greatly dissimilar from that used in Spain down to this day. In that country, the writer found it the common practice to mix a proportion of lime with the earth, the percentage varying from 10 to 33. The resultant walls, both new and old, attain an extraordinary hardness and are scarcely distinguishable from cement-concrete. This may well happen in the case of the chalk and earth pisé at Amesbury.

In addition to genuine pisé, cob-work and chalk-concrete have also been given a fair trial at Amesbury, but it is doubtful whether cob building can be profitably revived under present labour conditions, unless in exceptional situations. At Amesbury the cost was discouraging, but the chalk and cement method is distinctly promising.

To gauge properly the success of various building systems employed, and also the scheme as a whole, will require continued observation of the buildings for ten years, and a consideration of the facts which the building accounts and the estates' repair and maintenance records for the intervening decade will reveal. A visit to Amesbury 10 years hence should be exceedingly instructive, and might well lead to a revision of some of the present opinions held.

Even now, however, much has been learnt by those who have superintended the building operations, and also by those who have been able to visit Amesbury. Whatever the results, the Ministry's Amesbury experiment has undoubtedly a special and abiding interest to all connected with rural housing, or concerned in improving the amenities of rural England.

GRASS AND CLOVER SEED GROWING IN GREAT BRITAIN.

S. P. MERCER, B.Sc. (AGRIC.) LOND., N.D.A.,

*Chief Seed Analyst, Ministry of Agriculture's
Seed Testing Station.*

WHILE the British plant breeding and seed growing industries remain in their present state of development, it is not to be denied that in a few cases foreign seed is preferable to our own. It has, for instance, been shown with sufficient clearness, by Gilchrist's Cockle Park trials, that at least in the north-east of England, New Zealand cocksfoot is better suited for long leys than the various cocksfoots originating at home, since the New Zealand strain ripens later, and is therefore not so over-grown and coarse by the time harvest is reached. Further, there are undoubted instances where, under given conditions, and for given purposes, Chilian Red Clover is more suitable than English, and others where French Sainfoin is more profitable than the home-grown product. If these cases are examined, it is generally found that the qualities which give the foreign samples their superiority are such as could very well be made prominent in our own strains if careful selection were exercised—that is to say, they are not *new* properties which would need to be introduced, but properties which need *developing*. The available evidence goes to show that such improvements are not only possible, but would probably offer comparatively little difficulty. For example in the case of the Cocksfoot cited above, it would appear that by selection for lateness, British Cocksfoot could be brought to a condition quite equal to the New Zealand seed recently in demand. A further consideration (apart from the benefit to national credit) also arises in that we may not always be able to purchase seed from those particular world localities which produce strains suitable for our requirements. The same instance may again be cited—it has recently been extremely difficult, and often quite impossible, to obtain New Zealand grown Cocksfoot.

In the majority of cases, however, there is no doubt that farmers have every reason to prefer British seed. But the supply of British seed in the case of many species is not nearly sufficient to meet the demand. Taking the commonly used clovers, for instance, over the years from 1914-1918, the quantity

of foreign seed imported was probably about half as much again as the quantity grown in Britain.

It seems highly desirable, therefore, in view of the general superiority of English seeds over the foreign strains for use in this country, to extend the growing of agricultural crops for seed, in suitable districts.

With this question in view, and also that of the improvement of certain species by selection and breeding, a survey* of the seed growing districts in England, Scotland† and Wales was undertaken in 1919 with the object of ascertaining to what extent the various species were seeded in Great Britain, which districts had been found especially suitable for particular species, what were the climatic and soil conditions under which seed of the various species was produced, and to what extent and in which districts seed growing could be economically extended. The remarks which here follow present an outline of the information obtained and opinions formed during the course of the survey.

General View of the Position.—If a line be drawn from the north of the Severn mouth to the Wash, the principal districts which produce agricultural seeds will lie to the south of that line; a few detached counties and districts are of importance in the area north of the line, the most notable being Hereford, eastern Montgomery, the Vale of Clwyd, Ayrshire, and the carse of Stirlingshire and Perthshire. The comparison of a map so marked with a meteorological map shows that no relation can be traced between climatic conditions as regards rainfall and sunshine and the distribution of seed-growing areas. If comparison be made, on the other hand, with geological and drift maps, the connection between the seed-growing industry and the distribution of soils is fairly evident. In general, the heavy lands (largely those derived from boulder clay drift) are used for Red Clover seed growing; White is produced on heavy and medium soils; and Trefoil and Sainfoin are most strongly developed in calcareous districts, although both these stray on to the clayey land where the latter contains chalk. Grass seeds in England are only produced in quantity in the fen districts; smaller amounts are produced in other places as a by-product in the harvesting of clovers. The Scottish counties named produce Ryegrass and Timothy.

* A detailed report of this survey will be published by the Ministry later.

† The surveyor was enabled to visit the Scottish seed-growing districts by the courtesy of the Board of Agriculture for Scotland.

Red Clover.—At present the bulk of English Red Clover seed is produced in Essex, Suffolk, Norfolk, Bedford, Hertford, Kent, Sussex, Hampshire, Wiltshire, Dorset, Cornwall, Gloucester, Oxford, Hereford, Montgomery and Denbigh. The proportion of the county occupied by the seed crops varies greatly, however, and while, for instance, nearly every farmer in Essex north of Brentwood produces some seed in a good season, in Cornwall none is grown except in one very restricted area about Wadebridge.

To a great extent the more important Red Clover growing districts produce both Broad Red and Late Flowering Red (Single Cut Cow-grass); the two are so similar in morphology and as regards requirements, that this is to be expected. The amount of Broad Red produced in the United Kingdom appears, however, to be about five times that of Late Flowering Red. There is at present an increase in demand for home-grown seed of true Single Cut Cow-grass, and in some districts a regrettable confusion between the characters and qualities of Single Cut Cow-grass and those of ordinary Broad Red Clover, an undesirable state of affairs in view of the peculiar advantages possessed by each variety for special purposes. True Single Cut Cow-grass is a variety, the production of which could with advantage be materially increased. In the first place the increasing demand, mentioned above, would be better met by home-grown seed than by foreign. Secondly, in some of the heavy clover producing districts the industry suffers under the scourge of clover sickness, sometimes fungoid, sometimes due to eelworms. The fungoid type seems much more frequent than the eelworm type, and it is well established that true Single Cut Cow-grass is much less attacked by the disease than is Broad Red. Single Cut Cow-grass might very well be grown, therefore, in those districts where clover sickness inhibits the growth of Broad Red. Again, many growers in other areas are obliged to limit their Broad Red crops to one in every two rotations, and to insert some other crop, not used for seed, in the alternate cycles. This difficulty could be eliminated by the use of Single Cut Cow-grass alternately with Broad Red.

It should be noted by intending growers of Single Cut Cow-grass, that to obtain true and genuine seed in the first instance is of immense importance, and as the supply is none too plentiful it is not always easy to do so.

In this connection arises the question of *acclimatisation*. It is held by some men of experience and authority that strains

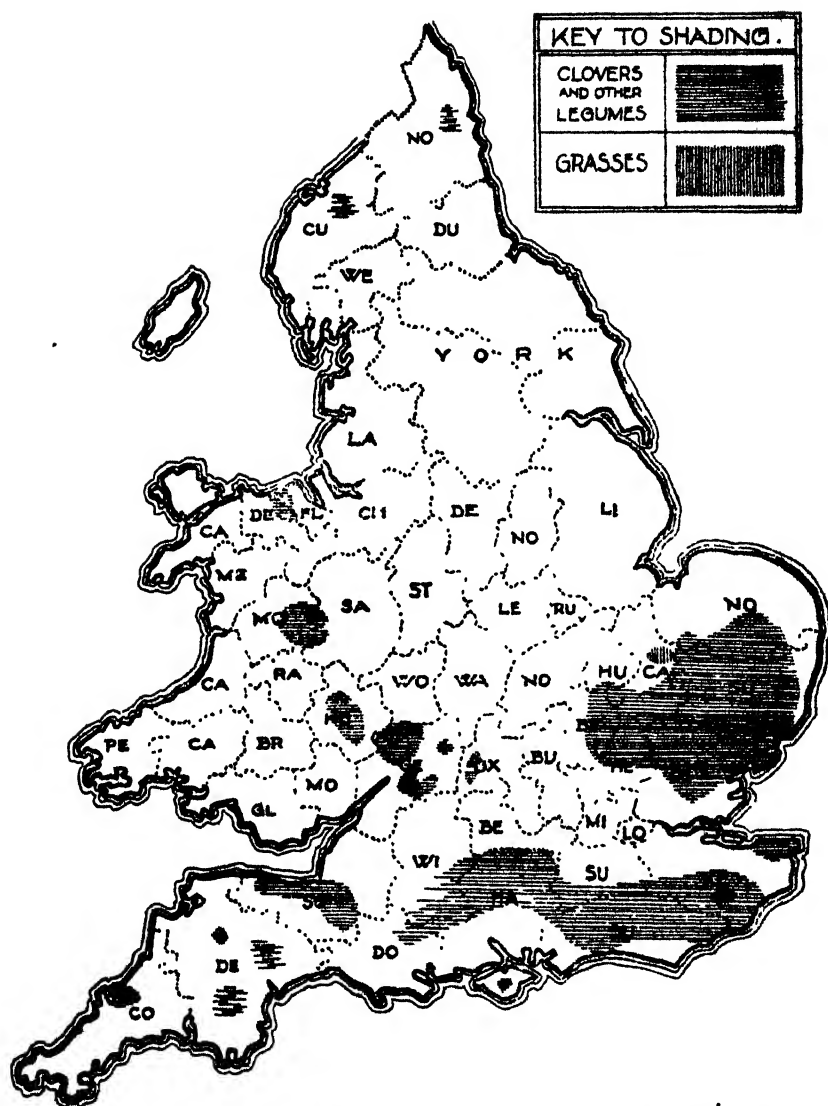
which have become "acclimatised" to a given district by continued growth over a large number of years in that district, are much more valuable for use in that locality than "imported" seed (even though brought from another part of the same country). This theory calls for consideration by seed growers and seed users, for even though it may not yet have met with general acceptance, there is considerable practical evidence supporting it, in more than one part of the country.

This matter also leads naturally to a consideration of the further question regarding the special value of indigenous strains which at the very least are certainly guaranteed to be thoroughly acclimatised in their own districts. It is strongly urged by some authorities, and it is the firm belief of the writer, that most valuable strains, both of grasses and legumes for use in Britain, could be raised by the collection and selection of wild British plants, and it has been definitely shown by practical trials in more than one case that this is so. Here, therefore, is another question which must be borne in mind in discussing the possibilities of British seed production.

The belief in the value of acclimatisation (though it may not have been recognised as such) has led in most of the heavy clover producing areas to the establishment of privately owned strains of clovers, which in many cases have been grown annually on the same farms for a great number of years, and which locally enjoy high reputations. Very few instances can be found where a definite practice of selection has been made in the establishment of these strains, although in some cases a very useful automatic selection has taken place, as for instance, in the case of certain sainfoins discussed below. The great danger connected with the continued growing of the same stock on the same farm lies in the risk of it becoming increasingly dirty. This need not happen, of course, if the grower is in a position to instal efficient cleaning machinery for his own use. Where such an installation is not available, *each season's produce should be sent to a merchant to be thoroughly cleaned before re-sowing.* The practice of selling the head seed each year and sowing tails to perpetuate the stock is to be most strongly condemned.

Details of cultural practice in the various parts of the country where Red Clovers are grown for seed will be given in the Report of the survey referred to above (footnote, p. 536).

- The average crop of Red Clover seed in Great Britain is about four bushels (about 260 lb.) per acre.



Map showing the areas in England and Wales which produce grass and clover seeds.

Alsike.—The amount of Alsike seed grown in Britain is very small, totalling only a small fraction of the amount purchased from abroad. Such as is grown appears to be produced mainly in East Anglia. A number of growers seem to have attempted an Alsike seed crop once, and never to have repeated the experiment. It may be that such cases gave poor results owing to the accident of bad season, or there are possibly factors connected with our climate and soil conditions which render an Alsike seed crop especially hazardous. Such factors, if they exist, are at any rate not obvious from a comparison of our conditions with those of, say, the North European countries where Alsike seed is produced. There would seem to be room for further trials of Alsike as a seed crop in our clover growing counties, and possibly also in other counties rather more northerly than those at present producing clover seed, before any definite decision as to the advisability of extending the industry is arrived at.

Good average crops in East Anglia have produced about 4 bushels of seed per acre.

White Clovers.—Most of our White Dutch Clover is produced in the eastern, southern, and south-central counties. In those districts the White Clover areas follow in a general way the outlines of those indicated for Red Clovers, except perhaps that the counties concerned produce White more regularly than Red on their lighter soils. White clovers possess the advantage over Broad Red of being much less susceptible to fungoid sickness, and herein lies a further possibility of increasing the clover output from suitable counties without running the risk of augmenting the already rife malady—rather, indeed with the prospect of eliminating it.

The chief point of interest with regard to White Clover growing is the extraordinary situation respecting Wild White Clover. It is inexplicable that, while the demand for Wild White Clover is so great, and while the price of the seed is so high, comparatively few farmers and very few districts have undertaken its production. Two factors seem largely concerned with the anomaly. In the first place, there are large areas—notably in South-west England and North Wales—where Wild White Clover grows abundantly in the natural herbage, and there is no necessity to sow it. It seems probable that because of this its immense value to husbandmen in less fortunate districts is not appreciated, and so no attempt is made to harvest it. The objection to districts thus geographically placed immediately presents itself, that the rainfall will be so high as to offer great difficulty

to harvesting operations. Wild White Clover, however, is always a light crop compared with Red, and farmers in the districts mentioned can and do successfully harvest the latter. Secondly, there is the objection, strongly felt in some districts, against any Wild White Clover other than that harvested directly from genuine old pasture. Such evidence as is available tends to show that Wild White once grown on arable land is quite as valuable as genuine old pasture seed. In spite of this there are many districts where the once grown product is persistently refused, and in view of this objection, counties eminently suitable for the production of Wild White from arable land have no encouragement to undertake it.

The title "Wild White from old pasture" is frequently assumed to be a guarantee that the field which produced the seed has been down to pasture over a large number of years. To many readers, the phrase probably conjures up a vision of pasture laid down something over twenty years ago, but one may easily be misled in this matter. Pastures are not infrequently sown down for the definite purpose of producing "Wild White from old pasture," and the product so styled is not, therefore, by any means always taken from plants of great age. It not infrequently happens that a purchaser buys Wild White once grown under the name of Wild White from old pasture, the only difference being that it has been once grown in a pasture mixture instead of on arable land. It is not suggested that the seed is any the less valuable for this—quite the contrary. The intention is simply to point out that the title "Wild White from old pasture" does not always guarantee that which it popularly suggests. Be it observed, however, that we do not yet know through how many generations a strain of Wild White Clover must be grown before it begins to lose its wild characters, so that although the number is probably much greater than one or two or even a dozen, in the present state of our knowledge care should be taken that Wild White once grown is the daughter of genuinely wild parents, and not the granddaughter or any more distant descendant.

The Dutch White Clover produced at home is in considerable excess of the amount imported from abroad, so that the need for augmenting the home production of this variety is not so marked as in some other cases. As regards the necessity of vastly increasing the output of British *Wild White*, however, there can be no question. It seems probable that Wild White can be

successfully grown upon a great diversity of soils, and there are one or two districts which excel in the great luxuriance and profusion of Wild White among the natural wild herbage. Particular mention may be made of the south-western country, including Cornwall, Devon and parts of Somerset and Dorset, and the Valley of the River Clwyd in Denbighshire and Flintshire.

There is evidence to show that even among strains of Wild White which are genuinely wild, acclimatisation to a given district has some effect on the strain. At present, however, the demand so far outweighs the supply that Wild White should be grown wherever conditions allow, and in as large quantities as possible; but intending growers should note that the crop is a very risky one, and that threshing and cleaning is an arduous and expensive business, so that very small quantities, although there may be a ready sale for them, may not always be profitable.

Average crops of Wild White in England vary considerably according to locality and season. Genuine old pasture produces up to three-quarters of a bushel (about 50 lb.) in a general way, and an arable crop will give, perhaps, a bushel and a half. Details as to cultivation and harvesting will be given in the Report referred to on p. 536.

Crimson Clover.—The demand for Crimson Clover in this country is small compared with the call for, say, Red or White, and its use is mainly confined to the southern half of the country. We produce at home considerably more seed than we import, but, generally, no individual grower seeds a large area. This is easily understood in view of the very risk nature of the seed crop. The ripened heads hold water well, and the attachment of the ripe pods is so brittle that shattering is very easy, so that from one or both of these causes the whole of a crop may readily be lost. It is common in the Crimson growing districts (East Anglia) for farmers to grow a breadth each year, using the major part of it as green fodder, and just seeding sufficient for their own use next season. An average crop yields about one sack of seed (about 260 lb.) per acre.

Lucerne.—English-grown Lucerne constitutes a small fraction only of our annual Lucerne consumption. There seems to be room for a good deal of experimental work in the production of the seed in this country. One of the principal factors bearing on permanence of Lucerne is longitude; while some

varieties will do very well in the eastern parts of England, their success is less and less marked as one moves westwards, until a line is reached about the middle of the country beyond which the crop is not profitable. Nevertheless, cases have been noted in counties considerably further west than this line, where the ordinary seed is not worth sowing, but where certain individual plants from a crop, if sown, will last up to twelve or fifteen years, while the rest disappear in the first two or three seasons. This suggests that a strain might with comparative ease be selected from among the ordinary Lucernes, which would stand quite well, even in the more western counties. In view of the valuable properties of good Lucerne, such selection ought to prove well worth while.

Sainfoin, Trefoil and Kidney Vetch.—These crops are usually to be found, as might be expected, in the chalky districts. The largest seed-producing areas are the chalky districts of the eastern counties, the northern part of Hampshire, and Oolitic areas in the Cotswold region.

The case of Sainfoin furnishes a very interesting and instructive object lesson in the matter of automatic selection. In Hampshire, long Sainfoin leys are employed, which frequently remain down for a dozen years or so; for such leys it is obviously necessary that a long-lived strain be employed. It is found that the sainfoins seeded in East Anglia will not stand in these leys for anything like as many years as Hampshire-grown Sainfoin. Here is a case, commonly ascribed to acclimatisation, the true explanation of which would seem to be that, whereas in East Anglia seed is taken from a Sainfoin crop at an early age (often in its second year), in Hampshire the crop is not harvested for seed until it has been down for some six or more years. Since short-lived strains commonly produce more seed per plant per annum than their longer-lived relatives, the effect in the one case will be to reduce the longevity of the strain by early harvesting through a succession of generations, and in the other case to enhance the permanence of the strain by ensuring that seed in each generation is only taken from the longest lived plants. These two practices, having been in operation for many years, have thus naturally resulted in Hampshire Sainfoin being a much more permanent strain than East Anglian Sainfoin.

Although in this particular case the effect has to a large extent been wrought involuntarily, there is no reason why the same system should not be employed with a number of other

crops, and probably very valuable strains could in many cases be obtained in this way.

Average crops of common Sainfoin produce about 8 or 9 sacks (about 800 or 900 lb.) of seed per acre, and of Giant Sainfoin, when seed is taken from the second cut only, as in East Anglia, about 5 or 6 sacks. Trefoil yields some 5 or 6 quarters of seed in cosh, though the crop is very variable in different districts.

Grasses.—Taken as a whole a much greater proportion of the grass seed which we use annually is produced at home, than is the case with clovers. Italian and Perennial ryegrasses and Timothy are the only three grasses produced on a large scale in Great Britain. Crested Dogstail is grown to a considerable extent in Great Britain, but Ireland is a much larger grower. In addition to these, small quantities of Cocksfoot, Meadow Foxtail, Sweet Vernal, Tall Oatgrass, Golden Oatgrass, Meadow Fescue and Rough Stalked Meadow Grass are grown.

Ryegrass.—As far as England and Wales are concerned, ryegrasses are grown to a large extent in one district only, the fens of north-eastern Cambridgeshire. The produce of this area is very largely Italian Ryegrass; Perennial is mainly grown in Ayrshire and in the carse in the neighbourhood of Stirlingshire.

A certain amount of "Annual" Ryegrass is grown in Ayrshire for use in the same district, but the grass does not appear to be sown in other parts of the country to any extent. This variety is not *Lolium westerwoldicum*. Its seed closely resembles that of Perennial Ryegrass, but is rather long and parallel-sided, compared with a typical sample of the latter. It appears to have been selected from ordinary Perennial, and is commonly used in a mixture with Timothy, the idea being that the ryegrass may be seeded in the first year and then die out, the Timothy being harvested in succeeding years. Its strictly annual character seems, however, somewhat doubtful.

A little Perennial Ryegrass used to be seeded in the Okehampton district of Devonshire, but the strain has now almost died out. As far as can be gathered it seems to have been a valuable ryegrass, and its revival might well be worth while. Ryegrass is seeded on a small scale under the name of Hampshire bents in the north and east of that county, and also in the Ringwood district, but the industry does not seem so general as formerly.

Ryegrass needs to be well ripened, and harvesting, therefore,

is not always an easy matter. There is an adage in Ayrshire to the effect that "the more you lose the more you get," that is to say, the crop must stand until the seed is ready to drop from the straw without much shaking. In a wet season in the fens, it is sometimes necessary to thresh the stooks by hand in the field when it is impossible to get them dry enough to stack. In Ayrshire it is not usual to stack Ryegrass at all, but to thresh straight from the rickles (pikes). An average crop from the first cut of a first year's growth of Italian in the fens is about 8 bags of 140 lb. each, or rather more. The autumn cut will yield some further 3 bags. In Scotland an average crop of Perennial is expected to yield about 8 cwt. of seed per acre.

It is desirable that a uniform system of buying and selling ryegrass should be set up. The present system where some sales are made by weight and others by volume, is not always conducive to high bushel weight.

Timothy.—By far the major part of our Timothy seed is Scottish; the carses of Gowrie and Stirling produce large quantities, and Ayrshire proportionally rather less. One of the main factors in cultivating Timothy for seed is cleanliness; a good clean Timothy ley may be kept down as long as 25 years, but unless the land is very clean to begin with and good seasons follow, this is not often possible. In bad circumstances crops may have to be ploughed out at the end of half a dozen years. Timothy is a rank crop which calls for liberal manuring; if a crop is well treated in this respect, seed may be taken from it every year after the first. Timothy is rather earlier to harvest in the east of Scotland than in the west, probably on account of the lower rainfall. A clean crop may be cut with a binder. Stacks are made in some cases but not in all, and an acre should yield some 4 cwt. of seed from an average crop. On stronger land 5 cwt. may fairly readily be obtained.

Crested Dogstail—As a constituent of permanent mixtures Crested Dogstail has latterly come into rather more favour than it enjoyed a few years ago, and it seems likely that the demand for it will increase, at any rate, for a short while. At present very little Dogstail is grown in Great Britain, the crops which are produced being frequently a by-product from another crop. The Kentish Wild White Clover pastures, for instance, produce a certain amount of Dogstail mixed with the Wild White, and it is a common practice to separate the grass when threshed from the clover, and to re-dress and market it. There are no districts of

note where Crested Dogstail is grown alone as a definite crop. In former years the grass used to be cultivated in Hampshire for the straw which was used in the manufacture of straw bonnets, but since the latter have gone out of fashion the Dogstail industry has been dropped. It is possible that its revival as a seed crop would be worth trial.

Cocksfoot.—Cocksfoot is one of the outstanding instances among grasses where there seem to be great possibilities for the development of English-grown strains. At present British-grown Cocksfoot only represents a very small fraction of our cocksfoot consumption, and as was pointed out at the beginning of this article, cocksfoots are very variable in character and quality, a fact which suggests that it ought not to be difficult to select strains especially suitable to Britain from among our indigenous plants. There is a remarkable growth of Wild Cocksfoot each year on the waysides and waste places of several districts, the most noteworthy being the south and south-western counties of England, where it is associated sometimes with Tall Oatgrass, and sometimes with Sweet Vernal. It seems probable that both Cocksfoot and Tall Oatgrass from such districts would repay cultivation and selection. In the case of Tall Oatgrass, however, very great care must be taken that the *bulbous* variety, which is largely represented among the wayside flora, be avoided in making the selection. The introduction of this weed into arable land would only spell disaster.

Failing selection from wild plants, the remarkably strong growth of these species in the wild state suggests that the cultivation of them in these districts would be a paying proposition, even though purchased seed were used.

The demand for Sweet Vernal is so small and its value in many cases so doubtful that it is a question whether the cultivation of the species in its present condition is to be recommended, but to judge from the character presented by some wild sweet vernals it seems highly probable that here again careful selection could provide a strain suitable for this country which would produce much more herbage than do our present vernals, in which case, in view of its earliness, the species would be considerably enhanced in value.

Meadow Fescue.—A few odd crops of Meadow and Tall Fescues are seeded in scattered districts, but there is no special area definitely committed to the production of them. *Festuca pratensis* appears to be a species which does very well in districts that suit

it, but it is not by any means universally successful. Since, however, we use much more seed than we grow, it offers perhaps the best case for trials, among the remaining grasses.

Other Grasses.—Meadow Foxtail, Golden Oatgrass and Rough Stalked Meadow Grass are grown to a very small extent in scattered districts, but all three together cover a very small area. Among them Meadow Foxtail seems to be in the greatest demand, and therefore perhaps offers the best chances for experiment, while the demand for Rough Stalked Meadow Grass, although small, is on the increase.

HOW TO PROTECT WHEAT: SOME NOTES ON FUNGUS PESTS. .

IN a time of wheat shortage throughout the world, every quarter grown in Britain is a national asset. There are two methods of augmenting the supply:—(1) by enlarging the area under cultivation, and (2) by increasing the yield per acre. The importance of the former cannot be urged too strongly. It is paramount. The possibilities of the latter are perhaps not always fully realised. Cultivation, fertilisers, and varieties materially affect the yield, and there is another factor equally powerful in making for increased supplies, namely, the control of fungus diseases.

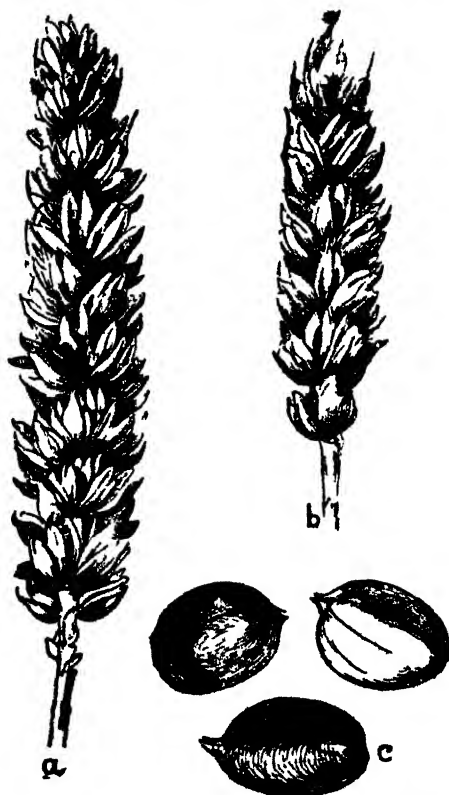
Exact figures are not available, but it is a lamentable fact that through the insidious workings of rusts and smuts alone several hundred thousand quarters of British wheat are lost annually. Each season parasitic fungi quietly but persistently steal a portion of the crop. They exact a toll on the nation's wealth and impose, as it were, a tax on the farmer's income. Whether he realises it or not, they reduce the farmer's income and rob him of his profits. This "fungus tax," however, should be contested, for the full amount need never be paid. A large "abatement" can always be obtained, and in some cases complete "exemption." Thus, by adopting proper measures an attack of Bunt or Stinking Smut can be entirely prevented, and the amount of Yellow and Black Rust largely reduced.

Though the diseases of wheat are very numerous, the most serious in this country at the present time are perhaps the three referred to above. Reliable preventive measures, already known to many farmers, have been found, and it is the object of this article to bring them to wider notice. If the advice here offered is taken, wastage of the 1921 crop through their ravages will be reduced to a minimum. As a result the farmer will reap a better harvest and will be able to present an additional contribution to the much needed general wheat supply.

Bunt or Stinking Smut.—In Bunt the ear appears normal, but the grains when broken are found to contain merely a mass of black spores which smells like putrid fish. The wheat plants are infected in the seedling stage, but for a long time hold their

own and develop normally. Finally, however, the fungus wins, completely destroying every grain in the ear and producing a mass of spores wherewith to propagate itself next season.

From reports furnished to the Ministry's Plant Disease Survey Office it would appear that in 1919 Bunt was more prevalent than usual, especially in the North and West Midlands. Particularly bad cases were also noted in Worcestershire and



a and b. Bunted ears. c. Bunted grain, containing black mass of bunt spores (magnified about four times).

Buckinghamshire; "Browick" was severely attacked in Herefordshire, "Victor" in Somerset and Devonshire, whilst "April Bearded," so extensively grown in the late districts of the West Midlands, Monmouth and South Wales, was very generally badly bunted.

Bunt may be prevented by "pickling" or treating the seed with a fungicide. In most of the best wheat districts proper pickling is regularly practised, and the crop, as a result, is clean. Where Bunt is present, inquiry has invariably shown that either no treatment was given or, if given, ineffective substances were

employed. The Ministry recommends *one or other of two substances only*, viz., copper sulphate (blue-stone) and formaldehyde. Other substances are commonly used, but these are for the most part useless. It should also be noted particularly that no substance has been discovered which affords protection from both birds and Bunt.

The secret of success in Bunt control lies in :—(1) the use of proper chemicals; (2) care in the method of pickling; and (3) the prevention of subsequent contamination by the admixture of untreated seed. It has been repeatedly proved that if these points are attended to complete elimination of the disease, even under farm conditions, can be obtained.

Treatment.—Even if there is no evidence that Bunt is present all doubtful seed should be pickled. For treatment with blue-stone the pure copper sulphate should be obtained, and a solution made at the rate of 1 lb. of copper sulphate to 10 gallons of water. The seed may either be thoroughly wetted with the solution on the barn floor, or steeped in a barrel for one to two hours, and afterwards spread out to dry. The formaldehyde method is, if anything, more satisfactory. With this substance 1 pint of commercial formalin (=40 per cent. solution of formaldehyde) is diluted with 20 gallons of water. (Smaller quantities may be prepared at the rate of two teaspoonfuls of formalin to 1 gallon of water.) The pickling solution should be thoroughly stirred before using, and should be applied to the grain in the same manner as the copper sulphate. If the steeping method is employed 20 minutes is sufficient, and the grain should be spread out afterwards to dry. (For full details see Leaflet No. 92.)

Yellow Rust. — The fungus causing Yellow Rust (*Puccinia glumarum*) is by far the most prevalent of all the wheat-attacking fungi in Britain. It is present to a varying extent every season even in the best wheat-growing areas, and in the case of most varieties probably occurs in every field. The disease is recognised by the innumerable, bright yellow spots or "sori" on the leaves. These sori contain a golden powder, the spores of the fungus which spread the disease. Sometimes the lower leaves only are attacked, but the upper ones often suffer also, the fungus spreading further to the ears and even to the grains. Owing to Yellow Rust being a "leaf rust" its effects are not so striking or disastrous as those of the "Black Rust," which is a "stem rust," and hence the damage inflicted is not always realised. The loss in the aggregate, how-

ever, is startling. Professor Biffen, in his essay on "Systematised Plant Breeding,"* writes with regard to this disease "what this (toll) amounts to on the average it is impossible to say at all definitely, but an estimate of from 5 to 10 per cent. is probably not very wide of the real figures." Applying even the lower figure to the year 1919, when 2,870,367 acres were under wheat, the amount lost by Yellow Rust (at an average of 4 quarters per acre) would be over 450,000 quarters. An allowance, however, must be made for resistant varieties.

The fact which every farmer should realise is that *this loss of crop is largely preventable*. There exist some good wheats which are very suitable for use in this country and are highly resistant to Yellow Rust. By the growing of these wheats the fungus is outwitted and the crop benefits in proportion. The three wheats resistant to Yellow Rust are "Little Joss," "Yeoman," and "Swedish Iron," the first two being raised by Professor Biffen at Cambridge. Unlike the susceptibility of potatoes to Wart Disease, where certain kinds are absolutely immune, these wheats sometimes show, specially early in the season, traces of Rust. They are, however, highly resistant, and always stand out in striking contrast to other sorts. No specially resistant spring wheat has yet been raised. In all districts where winter wheat is grown and Yellow Rust is prevalent, one or other of these varieties should be tried. Notes on their characters and their suitability for different areas are given below. Further advice may be obtained from the local Agricultural Collégé.

"*Little Joss*."—An excellent all round, red wheat of good quality; it tillers freely and matures early. It is particularly suitable for light and poor soils, late districts and exposed situations, but is not good for land which is cold and wet in winter.

"*Yeoman*" is a new wheat with short, stiff straw. It possesses high-yielding and first-class milling properties, and can be grown on almost all classes of soil. It does extremely well south of the Thames.

"*Swedish Iron*" is a stiff-strawed, large-grained wheat suited for good land in a high state of cultivation. It does well in the north and cooler parts of the country.

Black Rust.—*Puccinia graminis*, the Black Rust fungus, is without doubt by far the most serious of all wheat parasites. This is this fungus which causes the devastating epidemics in India, Australia, and America, and it is, in fact, liable to occur in epidemic form in any country where it exists. As an example

* "Science and the Nation," Cambridge, 1917.

of the damage this minute organism can bring about it may be noted that in 1916 it was responsible for the loss of 100 million bushels in the three prairie provinces of Canada, and in the United States of over 200 million bushels in North and South Dakota, Montana, and Minnesota alone. Fortunately for Britain, Black Rust of wheat is exceedingly rare in our islands, and has been regarded as practically non-existent. During the past few years, however, its occurrence in a certain district in Pembrokeshire has been observed, and inquiry has shown that the attack is of several years' standing and extends over a wider area than was at first thought. A special survey was commenced last autumn, conducted jointly by the Agricultural Department of the University College at Aberystwyth and the Ministry of Agriculture. From the results obtained by the Survey it appears that Black Rust in severe form now occurs annually over the whole of Pembrokeshire, Carmarthenshire and South Cardiganshire. The disease is locally termed "blast," and its appearance is often considered to be due to bad weather. The damage caused has been very severe. The fungus particularly attacks the straw, which it often completely cripples, and on which the black streaks of spore-masses develop. Losses of over 50 per cent. are frequent, and in some cases the entire crop is ruined and is not worth threshing. Not a few farmers in South Pembrokeshire have entirely abandoned wheat growing.

Although south-west Wales is mountainous and not a wheat growing country, the amount grown is highly commendable and is a material contribution to the nation's supply. The figures for 1919 are:—Cardiganshire, 7,208 acres; Carmarthenshire, 11,421 acres; Pembrokeshire, 3,484 acres. If proper measures be taken the yield from these 22,000 acres may probably be doubled.

The Barberry Menace.—Unlike Yellow Rust, Black Rust has a second host-plant, namely, the common Barberry, on which it occurs very widely. The injurious effect of Barberry on wheat has been known to farmers for upwards of two centuries. They affirmed, in spite of opposition, that it led to attacks of Black Rust, and subsequent investigation showed that they were right, the scientific proof and explanation being obtained many years later. The survey in Wales shows that the Barberry is generally and plentifully distributed in the three counties mentioned, occurring around the homestead and in the hedges. The fungus is found on the Barberry leaves in the spring in the form known as the "cluster-cup." Stretches of Barberry 100 yards long have been noted in lanes and on the roadside, sometimes covered

with the "cluster-cups" of Black Rust, from which spores were being discharged and blown in all directions. In another striking case a piece of Barberry hedge adjoined a wheat field, and the golden spores were being rained from the cluster-cups over very promising wheat. Isolated bushes of Barberry occur in other parts of England and Wales, but not to anything like the same extent.* The explanation of these severe attacks of Black Rust in the south-west of Wales is therefore clear; they are largely, if not entirely, due to the presence of Barberry. A full and illustrated account of this outbreak will be published shortly in the Ministry's *Journal*, but the present opportunity is taken of pointing out the danger so that every effort may be made to exterminate the shrub.

Although other factors may be concerned, there can be no question that the Barberry is the offender. The same shrub accounts for the enormous losses in the United States and Canada. A native of Europe and Asia, it has been planted in gardens in America and is now found wild along streams, rivers and roadsides. During the past few years the clearest evidence against the Barberry has been obtained in the Northern States. Each bush may commence a local outbreak, which serves as a centre from which the disease may, by means of its summer spores, spread for many miles. With a view to preserving the wheat crop an energetic Barberry campaign is now being carried out in Canada and in the United States. Similar campaigns have taken place in Europe. In Denmark, for instance, owing to the ravages of Black Rust, a law was passed in 1903 making the destruction of Barberry compulsory. From that date the disease commenced to die out, and is now practically non-existent.

No variety of wheat, suitable for use in Wales, can be recommended at present as immune to Black Rust. With a view to discovering whether any such wheat exists, over 70 varieties are being tested this season in Pembrokeshire and Cardiganshire. In the meantime attention should be concentrated on the Barberry. It should be rooted up, not merely cut down, wherever it occurs. Such a large number of bushes occur in the area that a determined and concentrated effort is needed. Every bush destroyed means a handicap on the spread of the fungus, and by energetic attack there is no reason why the fungus should not be eradicated, and as a result greatly increased wheat crops be secured.

* It should be noted that the Barberry which takes the Black Rust is the common or European Barberry, *Berberis vulgaris*. So far as is known, *B. Darwinii*, *B. stenophylla* and many other garden species do not become rusted.

THE NATION'S FRUIT AND VEGETABLES:

PROBLEMS OF PRESERVATION.

S. L. BENSUSAN.

IN the old days, when every country town or village was by way of being a self-supporting unit, when rail transport was scarcely known and the still room was yet an adjunct of every well-kept country house, it seems likely that there was little or no waste of fruit, flowers, or vegetables. The amount of produce that was likely to be consumed was well known, and at the same time there was a spirit of healthy competition among housewives, who regarded their special methods of making preserves, pickles, jellies, perfumes and simple medicaments as the best possible methods, greatly superior to those practised by their neighbours.

What a wonderful array of home-made produce the old-time country house could command! From a diary more than a century old, the writer has taken the following list of dainties made in a country house that stood some twelve miles from the Bank of England. The house has gone long since; a drapery store has usurped its place, lines of slate roofed villas stand on what were once secluded gardens, and electric trams rumble along where an orchard supplied most of the raw material for still room and kitchen. But the diary with its discoloured pages and rather angular, faded writing, still remains to tell the story of the Chatelaine's work and the results. Here are the good things mentioned in the diary as being made in the years when Mr. Pitt gave instructions that the map of Europe should be rolled up as it would not be wanted for many a day to come:—

Mallow Pâtés.	Cowslip Wine.	Crab-apple Jelly.
Elder Wine.	Dandelion Wine.	Barberry Jelly.
Elder Jelly.	Gooseberry Wine.	Quince Jelly.
Elder Flower Water.	Wild Cherry Liqueur.	Cranberry Jelly.
Lavender Water.	Black Currant Gin	Bullace Jelly.
Gilly Flower Water.	Sloe Gin.	Blackberry Jelly.
Parasnip Wine.	Sloe Tea.	Conserve of Wild
Rhubarb Wine.	Marigold Tea.	Strawberry.
Wild Rose Wine.	Apple Bread.	Damson Cheese.

With the growth of transport and the development of small towns into big ones, with the coming of the factory and the compulsion it exercised upon the lives of men and women, the small markets ceased to be small, and home-made produce fell from its high estate. The era of mass production had opened, Transport developed by road and rail, growing in utterly haphazard fashion

that took no note of anything beyond the requirements of the day and the convenience of the middleman.

There are two very definite results of this condition. In the first place, the grower is at the mercy of the market; in the second place, the urban consumer seldom or never obtains any advantage from Nature's bounty. If there be a shortage, he pays because things are scarce; if there be a very plentiful supply, he pays because there is no proper machinery to regulate market movements and no effective transport to take perishable goods quickly and cheaply to parts where they are required. The Astor Commission on investigating the conditions of our milk supply discovered that the average daily consumption per head in this country is under a quarter of a pint, and that there are whole districts in manufacturing centres where the milkman is almost unseen if not unknown. In like fashion there is no doubt but that a Commission on the distribution of fruit and vegetables would be able to show that while the consumption of fresh produce is limited to certain classes of the population, there are thousands of men, women and children who never obtain the really fresh supplies that are so important a factor in building up and maintaining health and strength. It is possible, round great urban markets, to see wagon loads of good food being taken to the destructor; it is possible in rural areas to see fields of cabbages and other vegetables being ploughed in for lack of a market. Pigs may be watched eating their fill on the floor of many an orchard, while the housewife whose purse is slender may be compelled to deprive her family of both vegetables and fruit or to purchase them in the smallest quantities at a high price.

This condition of things is, of course, due in the first instance to faulty organisation of markets, and perhaps in part to the greed of those who dominate them; but over and above this cause of trouble we have the national ignorance of the methods of home preservation. The Californian farmer who was asked what he did with his peaches said "We eat what we can, and we can what we can't," and we see the result of this method in the countless tins of fruit that reach our shores year by year. We see, too, the dried vegetables and the bottled vegetables, the crystallised fruits, the sauces, essences, pickles and the rest that are made in countries no more productive than our own, and are sent thousands of miles to pay a profit to the producer, the many intermediaries, the wholesaler and the retailer. This condition has obtained for many years, and it needed the great awakening of a world-war to establish a state of mind in which

people at home would realise that the utilisation of home-grown products is worth a very considerable national effort. By making this country able to turn its own to the best advantage, we place ourselves beyond the need of depending upon foreign supplies.

In 1914 the then Board of Agriculture appointed a special Committee, one of whose objects was to carry out experiments on a factory scale in order to improve the methods of preserving and drying fruits and vegetables. This object was sacrificed to some extent by giving over the factories at Dunnington and Broom in Warwickshire to increasing the food supply for the fighting forces by the manufacture of dried vegetables and jam. Since the close of the War the experimental nature of the work has received more attention, and the existence of many problems has been recognised. For example, shortage of sugar led to careful inquiry into the conditions under which the housewife makes jams, and it was found that she was using far more sugar than is required and producing far less jam than is needed. It was discovered, too, that certain classes of fruit and vegetables lend themselves much more readily to treatment than others, and that to obtain the best results a period of patient research was called for. The laboratory and the trained chemist must be available all the time, and fortunately there is at Long Ashton, near Bristol, a Government Research Station, directed by Professor Barker, that is at work on many of the problems which have assumed an almost national importance. With this Institution the Experimental Station at Campden is particularly concerned.

The Development Commission, to which this country is indebted for so much invaluable work, considered, when the War was over, the position of the establishments concerned with the preparation of fruit and vegetables for the Army, and came to the conclusion that, while some should be closed, the station at Campden in Gloucestershire might well be maintained and developed in order to demonstrate to traders, small holders and housewives the most economic methods of preserving vegetables and fruit, and to show all concerned how a surplus of any kind can be most usefully handled. In these days of great trading combines it is possible for a group of merchants to establish a laboratory and to employ skilled chemists, but it is, of course, unreasonable to expect that they will communicate the results of their work to the small man who desires to set up in business and is a potential rival. They are likely too to be more concerned with science as applied to commerce than with science as



Betty Thomas at Campden



Students engaged in Canning Operations, Campden

applied to production under the most hygienic conditions. The Government, without desiring to interfere in any way with the welfare of great firms and combines, does not wish to see the small man eliminated.

It has been the settled policy of the Ministry of Agriculture for some time past to develop horticulture in all its branches, and it may be taken to be a part of this policy that has brought the Experimental Station at Campden in Gloucestershire into being. In general terms the object of the station is to disseminate information that will prevent waste, enable surplus to be wisely used, and reduce the burden of expensive imports. The methods adopted are to train the trainer in the first instance, that is to say, to take people nominated by County Education Authorities, Agricultural Colleges and other educational institutions, and teach them how to teach. Then the small co-operative societies and even the householders can take their turn and obtain their training, while the man or woman who desires to set up in business on a small scale—a business which as it cultivates and handles the fresh fruits of the earth must be deemed to be extremely attractive—will find that the greater part of the problems that beset an endeavour on its way to success have been solved, and that the rest are in process of solution.

The range of teaching embraces at present canning and bottling, pulping, jam-making on practical and economical lines, the drying of vegetables, the making of pickles, preserves and liqueurs and the crystallising of fruits. One cannot help hoping that this programme will be extended in the future to cover the more attractive recipes of the old still room, that it will teach the possibilities of the herb garden, that it will give us the cordials of the old-time housewife, pleasant drinks like mead and morat, English wines and the best of the stock-in-trade of the herbalist: all those things, and indeed more than those things, referred to on the opening of this article. These developments find no place on the present programme of the Institution at Campden, but it may be hoped that they will arrive in time.

The Institution is at present in its infancy. Its singularly unattractive building is most happily set in a valley surrounded by orchards and has a railway station for neighbour. At the time of writing, the county bricklayers having decided to strike, building operations have been suspended, but the "Home Kitchen" Classes are being held, and only the Commercial Classes are postponed by the strike, possibly until the spring of next year. Canning, bottling, pulping and the rest are care-

fully taught, but always to limited numbers so that individual attention may be given, and the recommendation that follows a successful examination at Campden is being accepted already by institutions that are looking for skilled workers.

It must be remembered that the work when started in 1914 was on a very modest scale, that it was developed at first as a war-time undertaking, and that it is now in a state of transition from activities that had in them a definite commercial side, to work that is following scientific and educational lines as originally intended. At the same time the Campden Experimental Station is in the proud and rare position of being able to claim that it has carried on work in the public interest at no cost to the ratepayers. The profits on vegetable drying, jam-making, pulping and the rest in the factories at Broom and Dunnington have enabled £9,000 of the original grant to be repaid, and at this present moment the remaining assets exceed the balance of all liabilities by some thousands of pounds—a result that in the very nature of things must be unexpected when a Government undertakes emergency work in war-time and proceeds to develop an industry for national ends and without any care for commercial issues. It seems likely that Campden will continue to pay its way. The very clear system of accounts in vogue at Campden—a system that has won praise from gentlemen whose normal function is criticism—is a testimony to effective business management.

Students coming to Campden have accommodation found for them, arrangements having been made with various people in the neighbourhood to give board and lodging at, approximately, two guineas a week, and it may be that in the course of time, if the work develops, Campden will approach the status of an Agricultural College and that its recommendations will have even greater value than they possess to-day. Down to the present the only public attention that has been drawn to the work being done at Campden has been a circular letter from the Ministry of Agriculture to Local Authorities, and as a result of this, between the beginning of June and end of July 40 students took a fortnight's course. It is now found necessary to establish a waiting list in order that there may be no overcrowding.

¶ We have at Campden the beginnings of a great and significant experiment, one that may recover many half-forgotten secrets of the countryside, and may teach those who produce fruit and vegetables on the most modest scale some of the recipes that were known of old time only to the fortunate few.

THE HARVESTING OF MANGOLDS.

WILFRED S. MANSFIELD AND ARTHUR AMOS, M.A.,

School of Agriculture, Cambridge.

IN consequence of several complaints that reached the Cambridge School of Agriculture during January as to the poor keeping qualities displayed by some crops of mangolds that season, an inquiry was made in the Eastern Counties with the object of ascertaining the cause of the trouble. A total of 70 replies was received, which showed the following results:—

Variety.	Total No. of Returns.	Keeping Well.	Keeping Badly.	Keeping Indifferently.
Yellow Globes	... 44	30	11	3
Intermediate	... 10	7	1	2
Tankard	... 12	12	—	—
Long Red	... 4	4	—	—
Total	... 70	53	12	5

The season was an exceptional one, dry weather at sowing being followed by a dry autumn, with sharp frosts occurring unusually early, long before the bulk of the crop had been harvested. In spite, however, of the early frost no connection could be shown to exist between the crops which failed to keep and the frosting, except in the one case of the Red Intermediate mangold. The cause of failure in the remaining 11 cases, which were reported as keeping badly, was not so apparent, but it was found that the following points were common to each case:—

1. Harvesting began early—in the second and third weeks of October.
2. The land was dry and hard at the time of lifting.
3. The roots were carried free from any adhering dirt.
4. The mangolds were all of the Globe type.

Other factors which were examined included differences of soil, care in handling the roots, and manuring, but the returns showed that decay of the roots was independent of any of them. It may, therefore, reasonably be assumed that the decay of the mangolds was connected with the four above enumerated points which were common to all the failures.

On the Plant Breeding Farm at Cambridge, where similar Globe mangolds were pulled, topped and lumped early in October, the mangolds were intentionally left in the lumps protected with leaves, until rain had fallen and the roots had a chance to absorb water. These mangolds would thus have escaped the bruising of loading and unloading until they had had longer to mature and absorb water, and it was found that they kept well.

It was not possible to examine in detail all the cases of failure

reported, but on the University Farm, Cambridge, where one of the failures occurred, careful observations were made. It was noticed that decay always started either from the tip of the mangold, where the tap-root had been broken off or damaged in the process of pulling, or from various spots on the sides of the root which had been bruised, although every precaution had been taken to prevent damage in carting. In no case was decay observed at the crown of the root.

In no case, in which Globe mangolds kept well, did lifting commence before the last week in October, by far the greater part of the work being done during November, and in some cases as late as December. In two cases, however, Tankards, which were lifted in the third week of October, are recorded to have kept perfectly, and in one of these cases the Tankards were grown and harvested under identical conditions with the Globes which rotted.

The conclusions to be drawn from the facts recorded are :—

(i.) Globe mangolds, and especially the free-growing watery varieties, are less likely to keep well than the closer-textured Tankards and Long Reds, which contain a higher percentage of dry matter in the root.

(ii.) The primary cause of decay was early lifting and carting, when the ground and the mangolds were abnormally dry; the leaves were apparently ripe, but this was probably misleading and occasioned by the droughty weather.

(iii.) In one case Globe mangolds were lifted early, but not carted until wet weather set in. These kept well. It would seem, therefore, that under dry harvesting conditions, mangolds may be pulled and lumped, provided that they are not carted until wetter conditions prevail.

Among the replies received many sound precautions in the harvesting and clamping of mangolds were emphasised, of which the following may be mentioned :—

1. Mangolds should not be lifted until ripe.
2. Unless the roots are fully mature, they should be left a few days in lumps in the fields before carting and covered with their own leaves.
3. Care should be taken not to injure the skin of the roots, either with the knife in topping, or in carting. Forks should not be used in loading.
4. If exposed to frost in the field, ample time should be allowed for the frost to escape and for the mangolds to recover before they are touched.
5. The clamp should be covered with dry, clean straw, if possible; frost penetrates wet grass brushings much more easily.
6. Covering with earth should not take place until active heating has stopped.
7. Ventilation should always be provided at the top of the heap.

HAND LOOM WEAVING.

PROFESSOR A. F. BARKER, M.Sc.,

Textiles Department, The University, Leeds.

IN this and many other countries Home Industries Associations have often rendered important service. Individuals or communities, usually urged by some energetic and sympathetic personality, have developed an interest in one or other of the many forms of activity grouped under the term "home arts and industries." In some countries, as, for example, Canada, conditions have favoured the maintenance of such industries; but in England, of the many communal and individualistic industries started, very few have persisted. The question naturally arises, therefore, whether there is a place for home industries in England or whether the conditions are such that no industries of this type, even if started on a reasonably sound basis, can be expected to survive.

Until the industrial era of the Nineteenth Century the industry of hand loom weaving was almost solely of the home industry type, and it is possibly worth considering whether it can be re-established on successful lines. This will of course depend largely on whether hand-weaving can be made interesting, useful, and financially profitable.

There is no doubt that hand loom weaving in the home may be made an attractive pastime and within certain limits also a profitable occupation. With one or two possible exceptions, no serious attempt has yet been made to promote the study of the fundamentals of weaving, the knowledge of which would result in growing interest and steady application on the part of the workers. Should a thoroughly efficient business-like association ever be developed it is quite possible that eventually an art of hand loom weaving, approaching in interest that of tapestry weaving, might result.

An efficient loom, as well as an intelligent grasp of weaving mechanisms, cloth structure and colour is essential. Given the right type of loom, and knowledge on the part of the worker also, useful work can be performed. With a machine of useful width and construction and a supply of materials suited for weaving nicely coloured, sound structures, every normal well-trained weaver should be able to produce fabrics of excellent wearing quality and bearing some marks of the personality of

the producer, and yet quite equal to anything produced by the power loom.

Whether hand loom weaving can be made profitable must depend on two considerations, the direct and the indirect aspects of the industry. Directly, it is very questionable whether hand loom weaving will pay except in the manufacture of extreme fancies in either colour or figure. A plain industry, however, which is not directly a paying concern, may ultimately lead on to the real art-industry, and so may be well worth initiating. Thus under right conditions of equipment, control and sympathetic stimulation, even a plain industry, designed for the production of very simple fabrics, might almost be made to pay directly, and when indirect benefits were taken into account might very probably be developed on permanently successful lines.

Emphasis, however, should be laid upon the selling factor. In the case of such an industry as hand loom weaving some centres might be situated in proximity to pleasure or health resorts where there would probably be no difficulty in disposing of the surplus goods produced, but in organising hand loom weaving on a large scale it would be necessary to start selling agencies in suitable centres,* or else place the products of the industry in the hands of a really capable merchanting firm. If lasting success is to be achieved one if not both of these methods must be adopted. Considerable quantities of cloth might be disposed of among the surrounding village communities, and in some cases the industry would manufacture wool for the local farmers, but the produce of an efficiently organised industry would be sufficiently great to necessitate a larger outlook from the selling point of view.

Thus in facing the problem of making such an industry as hand loom weaving a real attraction in rural life, the factors of interest, of usefulness and of economic value should each be given due consideration. If the participants could form an association showing zeal and enterprise, remarkable results might be obtained. A Home Industries Association might also rear flocks of sheep producing wool specially suited to the requirements of the home industries. It might establish a woodwork factory of its own for the production of its spinning wheels, jennies, and hand-looms; start its own central wool carding plant, thus favouring the development of wheel or jenny spinning

* This has already been done in the case of the Canadian Home Industries Association.

in many communities; and also instal in the most suitable and central position its own "dyeing and finishing" plant.

For the successful commencement and maintenance of a scheme such as is outlined above, each worker should be made to feel that he or she is a factor in an interesting and growing industry.

The following requirements are essential in hand loom weaving:—

1. The possession of a really efficient hand loom. A loom well suited for the purpose has already been designed in the University of Leeds, and patterns would be at the disposal of a Home Industries Association.

2. The provision of yarns suitable in quality, thickness and colour. Temporary arrangements for securing this have already been made by the University of Leeds, which might also render valuable aid to associations to make permanent provision.

3. The assistance of intelligent organisers is very necessary. Even more skilful organisation is required for hand loom weaving than for power industries.

The "finishing" operations might well be arranged temporarily in conjunction with the Leeds University, or permanently with certain recognised dyers and finishers.

The necessity for the satisfactory disposal of the goods has already been referred to. The organisers of the several weaving centres should be kept informed as to which goods obtain a ready sale, so that such goods may be produced.

In conclusion, the writer would urge that unless such an organised scheme as that outlined is taken in hand, the question of hand loom weaving in rural districts is not likely to succeed. Even the smallest scheme would necessitate considerable capital expenditure, but the provision of the requisite capital might be made the test for sincerity and earnestness of purpose. It appears to the writer that the scheme would need to be stimulated by generous grants in the first place, but that the Association should ultimately be entirely in the hands of the workers. Some such scheme as that evolved for the Scientific Research Associations might well be adopted. The stimulus such a scheme might be to the worker can well be imagined. To control his own activities, to feel himself part of a growing, prosperous organisation, and to revel in "Threads of Thought and Colours of Fancy"—what possibilities there may still be of a happy, contented life in Rural England!

GROWING LATE FLOWERING RED CLOVER OR SINGLE CUT COW-GRASS FOR SEED.

LATE Flowering Red Clover or Single Cut Cow-grass is a valuable plant for inclusion in leys, especially in those remaining down for two years or more. This clover is a more bulky plant than Broad Red Clover, but it flowers and matures later, does not produce so much aftermath, and yields only one substantial crop in a season. However, it "holds" on the ground longer than other varieties; it often yields well in a second year's hay crop, and frequently contributes appreciably to the herbage in the third year. $1\frac{1}{2}$ lb. per acre should be included in the seeding of a two year ley and up to 4 lb. per acre in leys of from three to six years.*

Late Flowering Red Clover, although susceptible to clover sickness (whether caused by eelworm or stem rot) is more resistant than Broad Red Clover. In spite of these advantages the former is very sparingly used compared with the latter, and it is very desirable that its use should be extended. At the present time, a considerable quantity of the clover used in England is imported, and as, for long duration leys, it is important to use seed harvested in England, there is in this country a good opening for the growth of increased supplies. This end might be partly achieved if growers would substitute Single Cut Cow-grass for Broad Red Clover in every second or every third rotation; this is in itself a desirable procedure on account of the heavy annual loss through clover sickness in the clover growing areas—particularly East Anglia.

Growing for Seed.—Single Cut Cow-grass is principally produced in Essex, Suffolk, and to a less degree in the other Eastern Counties, and in Hampshire, Gloucestershire, Berkshire and Wiltshire.

Cultivation and Manuring.—The cultivation does not differ from that ordinarily adopted for the cereal nurse crops. A dressing of phosphatic manure should be given to the nurse crop, e.g., 5 cwt. of basic slag in autumn or 5 cwt. of superphosphate in spring, per acre.

Seed and Sowing—The only universally reliable character by which to distinguish Late Flowering Red Clover from ordinary Red Clover is the time of flowering. Locally grown seed should be sown, because the character of the crop can be

* At Cocker Park on soil very subject to clover sickness 5 lb. is included in a mixture for a one year ley.

definitely ascertained, while the buyer is exposed to risk (owing to confusion of names) if he buys seed elsewhere.

The seed should be drilled into the cereal crop at the usual time in spring at the rate of 8 lb. per acre. It should be rolled in, and if the soil is dry at the time of sowing heavy rolling is advisable.

Subsequent Treatment—After the harvest of the cereal nurse crop the clover should be rolled. The crop is not usually fed the same autumn, though calves are sometimes put on in Hampshire and sheep in the Isle of Wight (where growth is stronger). The clover may be slagged or dunged in winter, but usually is not directly manured. If it is intended to take seed it is not advisable to graze or mow for hay in the early part of the season. As a rule only one seed crop is taken from a ley. If cut for hay the first year a seed crop may come the second season.

Harvesting.—The crop is usually harvested in August or September, but it can stand later than Broad Red Clover, and may even be carried up to November, under exceptionally favourable weather conditions.

Readiness for harvest is indicated by the depth of brown colour of the field as a whole, and ripeness of seed is usually judged by picking heads and rubbing them out in the hand. The crop is cut with an ordinary mower, or with a side delivery reaper which leaves rows of little heaps instead of swathes; the self-binder has been successfully used.

It usually lies for about two days in good weather, and is then turned with the fork, the heads being kept up as much as possible. No wind rows are made—the small pikes are pitched direct. Stacks are made rectangular, rather long and narrow to prevent heating. If the crop is well dried, chimneys are not necessary.

Threshing.—Usually, threshing takes place the following spring; growers recommend that stacks of Late Flowering Red be left for threshing till after the other clovers have been dealt with. The operation is carried out with a “combined” threshing machine.

Crop.—The average crop is about 260 lb. per acre. A maximum of three times this yield may be obtained under specially favourable circumstances.

Disposal of Straw.—If fodder is scarce the stalks may be used as chaff in a mixed food for cattle, but this cannot be regarded as a high-class fodder. In other cases the stalks are used as litter.

DOMESTIC FRUIT BOTTLING WITH OR WITHOUT SUGAR.

FRUIT which is left exposed to the air will go bad. It may be preserved almost indefinitely if it is properly bottled. The reason why perishable fruits go bad so quickly is that under ordinary conditions the germs of decay present on their surfaces begin to grow, increase in numbers, and set up decomposition in the fruit. These germs may be already present on the fruit when it is put into the bottle, or, unless the bottle containing the preserved fruit is made air-tight, small quantities of air passing into the bottle may carry them in with it. In order to preserve fruit it is necessary : (1) to destroy or stop the growth of any germs already on the fruit, and (2) to seal the jar containing the fruit so that further organisms in the air are prevented from reaching it.

These objects are carried out by placing the fruit to be preserved in a suitable jar and then raising the temperature sufficiently to destroy or render inactive any germs present on the fruit. This having been done the jar is sealed so as to prevent germs from entering from the outside. The method of destroying the organisms or rendering them inactive is termed pasteurisation, and usually consists in heating the fruit in water or in syrup, though the fruit may also be heated whilst in a dry state, boiling water or syrup being poured over it afterwards to prevent it from drying during storage.

Bottling is the most economical method of fruit preservation at the present time when sugar is dear, because :—

- (a.) The use of sugar is not essential.
- (b.) The process is simple and inexpensive.
- (c.) Fruit can be preserved whole for tarts or stewing or in pulp for jam-making at a later period.

In view of the world shortage of sugar, the bottling of whole fruit cannot be too strongly recommended, because of all methods of preservation, this requires the least amount of sweetening to render the fruit sufficiently palatable for table use.

Method with Special Bottles or Jars.—Apparatus required:—

- (a.) *Bottles.*—Screw top or clip top glass jars are usually obtainable from any ironmonger. The cheapest type of jar has a tin lid, but this is not so good as the others mentioned. Screw top jars are the best,

though those supplied with a metal spring are quite satisfactory. Before use, the bottles—particularly new ones—should always be tested for flaws as the seating for the rubber bands is apt to be imperfect; sometimes a small ridge is left at this point in the making, and must be removed with a file in order that the cap will fit quite evenly with no sign of rocking.

- (b.) *Steriliser*.—When small quantities of fruit are to be bottled, a large saucepan, boiling pan, fish kettle, or similar vessel for heating water will suffice, provided it is deep enough. For fairly large quantities, a pan holding one or two dozen bottles is necessary. A sterilising outfit (several makes of which are on the market) may be usefully employed.

In using any ordinary pan as a steriliser it is essential that a false bottom be fitted, as the bottles must not touch the bottom of the steriliser or boiling pan. A wire frame or strips of wood nailed together trellis fashion will answer the purpose.

- (c.) *Thermometer*.—For successful work a thermometer is necessary. One of a "floating dairy" type which registers not less than 212°F. is very convenient, or the rather heavier stem variety answers quite well. A rubber washer will hold it in position.

Note:—It is essential that great care be exercised in the choice and renewal of rubber rings, as faulty ones are often the cause of failure. When rings are kept from one year to another they are apt to "perish." Unperished rings, when stretched, will return to their original size, and when pinched, will not crease. It is cheaper to cast a doubtful ring than lose a jar of fruit.

Selecting and Preparing the Fruit.—Slightly under-ripe fruit gives the best results in bottling. If all the fruit is not of this class, the ripe and unripe fruit should be separated and treated independently. Grade carefully so that each bottle contains even sized specimens. Wash well in cold water, with the exception of fruit like raspberries and loganberries; these would lose flavour if so treated. Preparation before bottling varies somewhat according to the fruit, *e.g.*, gooseberries should be topped and tailed; currants lightly shredded from their stalks; rhubarb skinned and cut into pieces of a uniform size; cherries must be

stalked, and, if possible, stoned; the hulls should be removed from raspberries; large juicy plums may be cut in half before being placed in the bottle; peaches and nectarines should be skinned, stoned and halved; apples and pears must be peeled and "quartered." A silver or plated knife only should be used for preparing fruit.

Pasteurising.—Pack as tightly as possible in the bottles without bruising the fruit. Fill the bottles with cold water to overflowing. Place on the rubber ring, cap, and screw band or clip; screw up and then release slightly to allow air to escape during pasteurisation. Clips or springs allow the air to escape automatically. Place the bottles in the pan in which they are to be pasteurised, the cold water in the pan being within an inch of the tops of the bottles. Different fruits require different treatments, but for most fruits the following method will be found satisfactory:—

(a.) *With Thermometer.*—Bring to the required heat slowly at the rate of approximately 2°F. per minute. A temperature of 155° to 180° is necessary. (See time-table at page 570.)

(b.) *Without Thermometer.*—Bring the water very slowly to simmering, or until the hand cannot be held on the pan lid. When this point is reached, lift up a bottle for examination. If the fruit is still firm in the bottle put it back in the pan, but so soon as it begins to move about when the bottle is twisted, it is ready to come out.

Should the water in the pan become too low through boiling, more should be added, but it must be of the same temperature as that in the pan.

When ready, the bottles should be removed, the covers at once securely fastened down, and the bottles allowed to cool slowly. Hot bottles must not be placed on anything cold, or they may crack. When quite cold, remove the screw or clip and test the seal by lifting the bottle by the cover. This test is possible if the bottle and fittings are perfect. If the lid lifts off the fitting is imperfect. Find the fault and remedy it, then re-pasteurise.

"Dry" Method of Bottling.—This method, which is more particularly suited for plums and gooseberries, is very simple and gives results somewhat superior as regards flavour to those obtained by the foregoing methods.

Pack the fruit tightly in the bottles and place in a slow oven until the fruit shrinks slightly; it is then ready to come out. Have boiling water ready, remove one bottle, fill up with the boiling water and fasten securely before taking another bottle from the oven. See that the lids and fittings are warm before being placed on the bottles. This method may be adopted with special bottles, or with ordinary bottles or jars sealed as described below.

Bottling in Ordinary Bottles and Jars.—Glass jars with a special device for sealing are to be preferred, and their use is strongly recommended, but if they cannot be obtained ordinary wide-necked bottles or jars may be used and sealed by one or other of the methods described below. The necks of the bottles should not be larger than is necessary for the insertion of the fruit, and should be so formed that air can be absolutely excluded by sealing. The chief difficulty in using ordinary bottles and jars is that of securing a sufficiently germ-proof seal. Several forms can be made to serve, if carefully applied, but it is advisable to examine the bottles in store from time to time in case fermentation or mould-growth occurs in any of them. If this happens, the contents should be consumed without delay, or the affected fruit should be treated again and re-sealed. Ordinary bottles or jars should not be packed so full of fruit as special bottles, on account of the sealing necessary to render them air-tight. Otherwise, pasteurisation should follow the lines of bottling in special bottles.

Methods of Sealing.—The old method of tving a piece of bladder over the mouth of the bottle is fairly satisfactory. Bullock bladders, obtainable from a butcher, should be washed and soaked in warm water to soften them before use. They should be tied on with string, having been cut previously into pieces of such size as will leave a fair-sized margin below the string after tying. Better results are obtained by purchasing parchment paper jam covers for pasting or gumming on, provided that the bottles are afterwards kept in a cool, dry place. Corks may be used instead of bladders, scalding them well first and then, after insertion, sealing the tops with sealing or bottle-wax. Mutton fat is sometimes used. It is poured on the surface of the water in the bottle so as to form, when cool, a solid*block of fat in the mouth of the bottle.

Other methods are :—

(a.) Two layers of parchment paper, pasted or gummed

- separately one over the other, placed over the bottle and tied with fine string.
- (b.) Three or four layers of writing or ordinary paper, pasted, gummed, or starched separately, one over the other, and then tied tightly with fine string.
- (c.) Three or four layers of tissue paper dipped in milk and placed separately over the mouth and tied tightly with fine string.
- (d.) Calico, linen or cloth, cut to size, with paper rounds to lie exactly on the top of the bottle. Melt together 1 lb. of resin, 2 oz. of beeswax, and 2 oz. of tallow, and paint the cut pieces of material. This sets in a few minutes, and a large number may be made at one time. To use, place the piece of paper on the bottle, lay the prepared seal over it and tie round.

The Use of Syrup.—The use of syrup is not essential, pure water being equally suitable and rather more transparent. Moreover, a thin syrup affects the natural flavour of the fruit without making it sufficiently sweet to render further sweetening unnecessary. Should sugar be desired, a syrup may be made by adding $\frac{1}{2}$ lb. to $1\frac{1}{2}$ lb. of sugar to one quart of water, and boiling until the sugar is dissolved. If syrup is used for "dry" bottling, it may be added to the fruit when boiling in lieu of boiling water. If used for the other methods of bottling, it should be poured on the fruit before pasteurisation, in place of water.

The Use of Saccharine.—The use of saccharine as a sweetening agent for bottled fruits is not recommended, but may be used, preferably when such contents are opened for table use. It is of the utmost importance that the solution made by dissolving

TIME TABLE.

FRUIT.	METHOD.	TEMPERATURES.	TIMES.
All soft and stone fruits.	Starting with cold water inside and out.	155° Fahrenheit	1½ hours, rising to 140° in first hour, and to 155° in next half-hour. Maintain at 155° for 10 to 15 minutes for stone fruits, and at 155° for 5 minutes only for soft fruits.
Apples and pears.	As above.	180° Fahrenheit	1½ hours, rising to 150° in first hour, and to 180° in next half-hour. Maintain at 180° for 10 to 15 minutes.
Syruped fruit.	Cold syrup inside.	10° higher than for each above.	1½ hours, as for each above.

saccharine in water should not be brought into contact with metal. For this reason it should be dissolved in a glass or cup and a wooden spoon used for stirring. On no account should it be used when bottles or jars having metal screw top fittings are employed. Saccharine should be added under the same condition as sugar (syrup) when bottling. The density of the solution will depend upon individual taste.

Causes of Failure.

- (1.) Over-ripe fruit.
- (2.) Imperfect sealing.
- (3.) Water too hot causing mushy contents. The temperatures must be strictly observed.
- (4.) Cooking too long. The times given must not be exceeded.

Points to Watch.

- (1.) Bottles must be scrupulously clean.
- (2.) Make sure that the false bottom is in the pan before putting in the bottles, otherwise they will crack. Do not allow the bottles to touch the sides or this also will crack them.
- (3.) Bottles should be screwed down tightly one at a time as they are taken out of the pan. Hot bottles must never be handled with a cold or damp cloth as this will crack them.

(This article will also be issued by the Ministry as Leaflet No. 250.)

GOOSEBERRY GROWING.

GOOSEBERRIES are extremely valuable to the market grower both when grown by themselves and as bottom fruit in plantations. Owing to the climate they can be grown to greater perfection in this country than in any other. Of late years extension of their culture has received a set-back from American Gooseberry Mildew, but with the better control of that disease the position is now much improved. The profitable life of well-cared-for bushes may be said to be about 15 years.

Varieties.—In selecting varieties for planting, due regard must be paid to the locality, the particular demand to be met, and to likely facilities for picking. They may be divided into distinct classes:—

- (a) In certain early districts such as the Cheddar, Exe and Tamar Valleys in the West, and Sandwich in Kent, it has been found most profitable to grow gooseberries for the early green berry trade, and for this purpose Berry's Early and May Duke are the most useful. These are usually marketed in chips or strikes.
- (b) The heavy cropping varieties such as Whinham's, Berry's Early, Crown Bob, Lancashire Lad, Careless and White Lion, may be picked for sale as green berries, or for jam, or when ripe for dessert. The bushes are usually picked over a number of times. The quantity left to ripen should be governed by the amount of other fruit likely to be on the market, and facilities as to picking. They are marketed in half sieves. If sold for jam the bushes are cleared before or at latest when the berries begin to change colour, and the fruit is sent in half-sieves or in bags.
- (c) Certain districts find it most profitable to specialise in high quality dessert fruit. For this purpose Careless is grown in Wisbech; Cousin's Seedling in East Kent, especially around Sandwich, and now, to some extent, in Wisbech; White Lion in Middlesex; and Early Sulphur in Middlesex and the Sandwich district in Kent. In addition there are the varieties

such as Gunner, Leader, Leveller, &c., which receive very special culture to produce the finest dessert fruit in the East Grinstead and Worthing districts in Sussex. In marketing these the 4 lb. chip is generally used, but Early Sulphurs from Kent are often sent in Peach Boxes holding 10 lb., while Leveller is carefully graded and the first grade packed in shallow boxes.

Propagation.—This is effected by means of either layers or cuttings, the latter being the better method and more commonly used.

Layering consists in bending down strong healthy shoots and covering with earth to a depth of 8 or 9 in., leaving 6 or 8 in. of their tips free. This should be done about the end of June. In autumn these branches should be cut from the bush and lifted and, where a large root system has been formed, it may be divided into two and both the upper and lower portions of the stem used to form young plants. Although the buds on the lower portion will when it is planted out be upside down, this will not materially affect the young shoots, which behave quite normally.

Cuttings may be taken in the autumn from healthy, well developed ripe wood of the same season's growth as soon as growth has ceased and the leaves have fallen. Weak or rank material should be avoided, as it does not produce good stock. The thickest wood only should be used and this should be cut from 8-10 in. long and, if possible, with a heel or small piece of the preceding year's growth, on account of the large number of dormant buds at the base which readily break, whereby roots are rapidly formed. Cuttings should be planted about 6 inches apart in rows 30 inches apart with as little delay as possible, to avoid any drying out. If, however, the ground is not ready, or the weather is unfavourable, the planting should be postponed until early spring, the cuttings in the meantime being carefully bedded in a sheltered position or stored in moist sand or moss in some suitable shed or building. It is most important that the cutting bed be of a light friable well drained soil, somewhat "sharp" and "in good heart," or poor root systems with correspondingly poor growth will be obtained. The usual method of planting is to take out with spade or plough a furrow with one

vertical side 6 inches deep. The cuttings are placed about 6 inches apart against the vertical side, the ends pressed into the solid ground, and the soil returned 2 inches at a time, each layer being carefully trodden. The secret of success is firm planting; and if the cuttings are lifted at all by frost they must be trodden tight again. In the early spring the top few inches of the land should be kept well hoed to prevent the cuttings drying out.

If required for bushes on a "leg" the cuttings should be disbudded except for some 3-4 buds at the apex and those immediately at the base, the production of suckers being thereby prevented. If, however, for bushes on a stool, no disbudding should be done, as the production of suckers is required for replacing old or diseased branches. During the two following seasons the young bushes will require thorough cultivation and spraying, and in the autumn two years after planting should be ready for planting out in their permanent position.

Location—Soil.—In order to minimise the risk of American Gooseberry Mildew it is important to select a well drained unshaded site where there is a free circulation of air, as close humid conditions are very favourable to the development of the disease.

Gooseberries prefer a deep, cool, well drained loam, but will do almost anywhere, except on extreme soils which are hot and dry or cold and wet. On the lighter soils considerable assistance from bulky organic manures is required.

Preparation of Land for Planting.—The land to be planted out permanently should be thoroughly cultivated to a depth of 12 in. or 15 in. by ploughing, sub-soiling and cultivating, or by double digging.

The best crops to take prior to planting are either potatoes or some other root crop, which permit of the land being thoroughly cleaned, cultivated and manured. If, however, the land has not previously been well done it should be given, prior to ploughing, a dressing of 15-20 tons of dung per acre or an equivalent dressing of some other organic nitrogenous manure.

It is extremely important to have the land clear of couch, twitch, &c., before planting, especially if the bushes are to be grown on the "stool" method. If the soil is thought to be in the least degree acid, or has not been limed for a number of years, it should be given a good dressing; the expense will be well repaid.

Planning.—Gooseberries are best set at 6 ft. square either

when grown by themselves or used as bottom fruit in a mixed plantation. They may be set closer in the rows, and for weak or upright growing varieties such as Lancashire Lad 5 ft. square is often sufficient. Sunshine and good air circulation are such an important aid in the control of fungoid pests that it is essential to avoid overcrowding, especially in mixed plantations. Generous spacing also permits of a maximum amount of horse cultivation.

Forms of Bush.—Gooseberries are usually grown either on a 6-8 in. leg or as true bushes on the stool principle. The former has the advantage of enabling the land to be properly cleared of twitch, &c., but should only be employed on rich soils where the branches are not liable to die back.

The latter is more suitable on the lighter lands, where the branches die back, as these can readily be replaced by the strong suckers which the system produces.

Planting.—Gooseberries may be planted in the autumn, winter, or spring, whenever the land is in good friable condition. If cold wet weather commences unusually early the planting is best deferred until the spring, and the young stock should always be carefully heeled in. Before planting, all broken or straggling roots should be trimmed off and the three to four main shoots cut back about two-thirds to an outside terminal bud. Planting is best done with a spade. The roots should be well spread out and the soil put back should be firmly trodden.

If the bushes are to be grown with a "leg" they should be planted at the same depth at which they were growing in the nursery row; but if for the "stool" form of bush, the lowest branch should start just below the surface of the soil to encourage the production of suckers.

Manuring.—Gooseberries must be generously treated in the matter of organic manures if good bushes carrying heavy crops are required. They respond remarkably to good farmyard manure. Good shoddy, fish, meat meal, or crushed hoofs may be used. Basic slag on heavy soils, or bone meal and kainit on light soils may be applied when these dressings are not given.

Unless the land contains a sufficiency of lime it must be kept well supplied with it. One ton per acre of fresh burnt water slaked white lime every two or three years is sufficient. On the stiffer soils an annual dressing of 5 cwt. per acre of ground white lime is suitable, or on the lighter lands two tons of small chalk every two or three years.

For further information as to manuring, *see* Leaflet No. 814; and as to Liming, Leaflet No. 170.

Cultivation.—The land must be kept in good tilth to conserve moisture, especially while the crop is developing, as on the vigour of the bushes the weight of the crop depends to a large extent. Several hand hoeings will be necessary, and the horse hoe or cultivator should be used every fortnight—especially as soon after heavy rain as possible—until the berries are picked. During the latter part of the summer no more cultivation should be given than is necessary to keep down weeds, otherwise late sappy growth may be encouraged.

Pruning.—With Gooseberries, fruit is borne at the bases of short spurs on wood from 1 to 10 years old, but the finest fruit is produced on young vigorous wood of the preceding year's growth. It will therefore be seen that it is essential to practice a system of pruning sufficiently hard to produce plenty of young growth, and, with varieties which do not form natural spurs readily, a system of spur pruning will be required. Unless closely pruned the weak growing varieties would soon lose vigour, but strong growers, such as Whinham's Industry, require more latitude on good soils, and the leaders of these should not be shortened after the first two or three years.

At the end of the first season's growth 5 to 6 of the strongest shoots should be selected to form the foundation of the bush and should be cut back from one-half to two-thirds according to their vigour, the weaker being cut harder than the stronger, and all remaining superfluous material should be cut back to spurs 1 in. long for the production of fruit buds. It should be borne in mind that the position of the terminal bud which is left aids in determining the direction of the following season's growth of the branch.

During the succeeding annual prunings, the chief points to remember are :—

- (1) Do not crowd the bush with too many main branches, which should be so spaced as to admit the sun's rays and the hand of the gatherer. Increase the number as the bush increases in diameter, but keep them well spaced, yet at the same time well furnished with laterals and fruit spurs.
- (2) Cut back sufficiently hard to keep the bush vigorous, to ensure a supply of young wood and to cause buds

to break and form fruit spurs, instead of remaining dormant and leaving lengths of bare wood. This cutting back must not of course be excessive, or nothing but a forest of sappy growth subject to disease will result. The severity of the pruning should be governed by the condition of the bush and the response made to the method adopted the previous winter.

- (3) Never allow any intercrossing of shoots and cut back everything growing inwards and tending to choke up the centre of the bush. Very strong shoots should be cut right out, as spurs from these rarely form fruit buds and merely produce increased wood growth.
- (4) Aim at replacing old worn-out wood with healthy young shoots or suckers. If this is done regularly the vigour of the bush is maintained and the length of its profitable life much prolonged.
- (5) The weight of fruit, especially in the case of varieties of a spreading habit, frequently tends to cause excessive drooping of the branches, which leaves the centre of the bush unduly open. These and the lower and outside branches should be cut back to an upper bud and new material trained to fill the head.
- (6) Varieties differ in habit and strength of growth, and in their readiness to form fruit spurs. As with other fruits, to obtain the best results each variety requires a careful study of its habits and a system of pruning calculated to counteract its weaknesses and beneficially assist its peculiarities.

Fungoid and Insect Pests.—The Gooseberry, in common with other cultivated fruits, is subject to attack by several insect and fungoid pests, the more serious of which are mentioned below.

American Gooseberry Mildew (*Sphaerotheca Mors-uvæ*, Berk).—Fortunately this disease can be controlled by the careful tipping and burning in the autumn of all diseased shoots, combined with thorough sprayings with lime sulphur spray as the buds are bursting in the spring, just after the blossoms are set, and in the late summer after the fruit is picked. Certain varieties are damaged by lime sulphur, and half-summer strength should be used on Keepsake (Berry's Early), Lancashire Lad,

Careless, and Crown Bob. Yellow Rough (Golden Drop) cannot safely be sprayed with lime sulphur at all. 'See Leaflet No. 195.)

Gooseberry Sawfly (*Nematus ribesii*, Curtis).—The larvæ of this sawfly are frequently very troublesome, attacking the leaves and young fruit which are sometimes entirely cleared off. They are, however, easily checked by thorough spraying with arsenate of lead at the rate of 4 lb. to 100 gallons of water. This spray must not be used within six weeks before the fruit is gathered. For other washes see Leaflet No. 12.

Aphides.—Various species may—when conditions are favourable—increase to such an extent as to damage the bushes seriously and prejudice the crop. They may be controlled by very early spraying before the curling of the leaves prevents them being wetted. If the leaves have been allowed to become badly curled, the infested tips should be picked off and burnt. (See also Leaflets Nos. 68 and 104.)

Red Spider (*Bryobia ribis*).—This is really a mite, scarcely visible to the naked eye, and may prove very troublesome in drougthy summers. Its presence is usually first detected by the characteristic yellow and sickly appearance of the leaves. It may be eradicated early by application of oil emulsion, liver of sulphur and various proprietary washes.

List of Standard Commercial Varieties.

VARIETY AND SEASON	DESCRIPTION.
Careless	Chiefly grown in Wisbech and East Anglia.
Cousen's Seedling ... (<i>Sandwich Yellow</i>)	Chiefly grown in Kent and Wisbech.
Crown Bob	Distributed over a large area.
Howard's Lancer ...	Very similar to White Lion.
Keepsake (<i>Berry's Early</i>)	Widely distributed.
Lancashire Lad ...	Widely distributed.
Whinham's Industry	Widely distributed.
White Lion	A Middlesex favourite.

Descriptive List.

VARIETY AND SEASON.	DESCRIPTION.
Crown Bob ... Midseason.	For picking green. Large, red, thin skin, hairy. Growth strong and spreading.
Careless ... Midseason.	Chiefly grown for jam or picking green. Large, creamy white, smooth skin. Growth rather slender and spreading. Suitable for Wisbech or East Anglian districts.
Cousen's Seedling ... (<i>Sandwich Yellow</i>)	Late dessert. Medium size, yellow, hairy. Makes a small pendulous bush. Much grown in Kent, now also Wisbech.
Howard's Lancer ... Midseason.	Dessert or picking green. Very large, greenish white, smooth, carries well. Growth strong and rather spreading.
Keepsake ... (<i>Berry's Early</i>)	Ripens late, but one of the earliest for picking green. Medium size, green, hairy. Growth pendulous.
Lancashire Lad ... Midseason.	Dessert or picking green. Large, dark red, hairy. An old favourite, but still does well in most localities.
Whinham's Industry Midseason.	For picking green or for jam or cheap dessert trade when colouring. Large, red, hairy. Growth strong and upright. A favourite market sort, as it succeeds on most soils; is a very heavy cropper and the fruit carries well.
White Lion ... Very late.	Very late. Useful as dessert or may be picked green. Large, white, slightly hairy. Growth strong and spreading. Extensively grown in Middlesex on the extension system.

(The above article will shortly be issued by the Ministry as
Leaflet No. 346.)

FEEDING STUFFS IN SEPTEMBER.

PROFESSOR T. B. WOOD, C.B.E., M.A.

Animal Nutrition Institute, Cambridge University.

ON the whole there has been very little change in prices of feeding stuffs since last month. English oats are slightly dearer, and imported oats distinctly cheaper, palm-kernel cake has risen in price by 5s. per ton, and ground-nut cake fallen by about £1 per ton, and there have been a few other small changes, but nothing to alter the situation.

Name	Price per Qr lb	Price per ton	Mineral Value per ton	Food value per ton	Starch equiv per 100lb	Price per Unit Starch Equiv	Price per lb Starch equiv
Barley English feeding	90 - 400	25 0 0	1 1	23 14 0	71	8	8 60
Foreign	80 - 400	22 10 0	1 6	21 4 0	71	8 11	8 17
Oats English	70 - 330	23 10 0	1 9	22 1 0	59 5	7 5	4 00
Foreign	57 6 - 420	20 0 0	1 1	18 11 0	59 5	6 8	3 46
Maize Argentine	68 - 480	18 2 0	1 5	14 17 0	81	3 8	2 00
Beans English spring	115 - 532	24 4 0	3 1	21 3 0	66	6 5	3 45
winter	95 - 512	20 0 0	3 1	16 19 0	61	5 1	2 72
chick	11 - 112	13 0 0	3 1	15 10 0	66	4 10	2 10
Peas English blue	100 - 504	22 4 0	2 13	14 11 0	69	5 8	3 00
dun	97 - 504	21 15 0	2 13	13 2 0	63	5 1	2 95
marple	123 - 514	27 5 0	2 13	24 12 0	69	7 2	3 85
Japanese	112 6 - 504	24 17 0	2 13	22 4 0	69	6 5	3 45
Buckwheat	102 - 400	28 10 0	1 10	27 0 0	53	10 3	5 50
Rye English	91 - 450	21 5 0	1 8	19 17 0	72	5 6	2 95
Millers offa - Bran		14 10 0	1 10	12 0 0	45	5 4	2 87
Coarse middlings		15 10 0	2 10	13 0 0	64	4 0	2 15
Barley meal		26 0 0	1 6	4 14 0	71	7 0	3 75
Maize		18 0 0	1 5	16 15 0	81	4 2	2 25
Beans		21 0 0	3 1	18 11 0	66	5 8	3 00
Fish		25 0 0	7 12	17 8 0	53	6 9	3 60
Cakes - Linseed		21 0 0	3 12	17 8 0	74	4 8	2 62
Soya		19 15 0	5 8	14 12 0	69	4 3	2 27
Cotton seed		12 10 0	3 5	9 5 0	49	4 4	2 82
mild deoorticated		20 0 0	5 6	14 14 0	71	1 2	2 25
Coconut		13 10 0	3 0	10 10 0	79	2 8	1 48
Groundnut		14 0 0	3 0	10 11 0	57	3 6	1 97
deoorticated		17 0 0	5 5	11 15 0	73	2 3	1 74
Palm kernel		11 15 0	2 1	14 0 0	75	1 7	1 39
meal		12 5 0	2 1	10 4 0	75	2 8	1 43
Brewers grains dry		10 10 0	7	8 0 0	49	3 4	1 79
wet		1 0 0	12	13 0 0	15	10 1/2	4 7
Distillers		11 10 0	16	8 11 0	57	3 1	1 65
dry		1 7 6	13	14 6	16	11	4 9
wet		8 12 6	3 6	5 6 6	43	2 6	1 34

Cereals generally are still relatively dear, costing 8d. or more per lb. of starch equivalent. Exceptions are Argentine maize, coarse middlings and dried grains which provide starch equivalent at about 2d. per lb. Beans and peas are about the same price per lb. of starch equivalent as cereals. Cakes and oil seed meals are considerably cheaper, the cost per lb. of starch equivalent being from 2½d. in linseed cake to less than 1½d. in coconut and palm-kernel cakes.

There is greater choice of feeding stuffs on the market than there was some time ago. English beans and peas, buckwheat and rye are now quoted.

Uncorticated Cotton Cake.—It is satisfactory to notice that the cake likely to be in most immediate demand, namely, uncorticated cotton-seed cake, at £12 10s. per ton, provides starch equivalent at the reasonable price of less than 2½d. per lb. At this price it will probably be widely used for milch cows at grass. It is specially suitable for this purpose as its astringent properties prevent scouring when the grass becomes watery in the early autumn.

Palm-Kernel Meal for Pigs.—Since last month Messrs. Mackenzie and Fleming have issued, under the title of *Modern Pig Keeping*, a pamphlet which describes the results of many pig-feeding trials carried out at Cambridge between 1917 and the present time. Their trials have demonstrated the suitability of palm-kernel meal for all kinds of pigs when used under proper conditions. For young growing pigs it should be supplemented with dried blood or some similar product, for fattening pigs with maize meal or some other starchy fat-producing food. Copies of the pamphlet can be obtained for the cost of postage from the Secretary, School of Agriculture, Cambridge. Pig keepers will find the use of palm-kernel meal most economical, as it provides starch equivalent at less than 1½d. per lb. as compared with 8d. or more in the case of most cereal meals.

Dried Blood.—Manufacturers of feeding stuffs appear to be turning their attention to the preparation of suitable samples of dried blood. Foods of this kind, which are prepared from animal products, require great care in their manufacture. If prepared from the blood or offals of diseased animals they are liable to transmit disease. If not properly dried they will not keep. When prepared with proper care, it seems likely that they may be very useful additions to cereal or other meals as sources of protein and of accessory food factors or vitamins.

Fish Meal is another feeding stuff of this kind, but its manufacture has now been standardised. Formerly all kinds of fish refuse were dried together and sold as the evil-smelling product known as fish guano. In this form it could only be used for manure. The fish refuse is now carefully selected. Some of it is still used for making fish guano, but the better stuff is steamed, extracted, dried and ground to a meal, which has little smell,

is fairly acceptable to animals, and has a constant composition of about 55 per cent. protein, 4 to 5 per cent. of oil, and not less than 16 per cent. of phosphate of lime. It should not contain more than 12 to 18 per cent. of water and 4 per cent. of salt. Buyers should see that they get a standardised product of about this composition.

Fish meal of this kind was tested on many occasions during the later stages of the War, and found to be suitable for a great variety of purposes. In using it for all purposes certain facts must be borne in mind. In the first place it contains no carbohydrate, and since this is a necessary constituent of the diet of farm animals, fish meal should always be used in conjunction with starchy foods. Secondly, fish meal is so rich in protein and ash constituents that it is not suitable to form more than a small fraction, say, one-eighth to one-twelfth of the whole diet.

With these reservations it may be used successfully for all kinds of stock—cattle, sheep, pigs, and even horses. Special notes on the use of fish meal appeared in this Journal for August, 1919, p. 480, and August, 1920, p. 414.

Note.—In the issue of this Journal for August (page 415) was given a "Standard Analysis of White Fish Meal," to which the Association of Fish Meal, Fish Guano, and Fish Oil Manufacturers—representing nearly all the manufacturers of fish meal in Great Britain—have agreed to conform. An error in printing occurred in this issue, and the analysis is here reproduced in its correct form.

Albuminoids	-	-	-	-	Not less than 55 per cent.
Phosphate of Lime	-	-	-	-	" " " 16 " "
Oil	-	-	-	-	Not more than 5 " "
Salt	-	-	-	-	" " " 4 " "

INSECT AND FUNGUS PESTS IN SEPTEMBER.

LITTLE can be done during September to prevent damage by the pests which are now apparent, as during this month crop, of all descriptions are being harvested. Notes should be taken, however, of the pests which are prevalent and the damage they cause, in order that precautions may be taken in another season to prevent similar damage.

Vegetables.—Among the general pests causing damage at this period may be placed the various *Cut-worms*. These are the caterpillars of certain moths such as the Turnip Moth, the Heart and Dart Moth, the Yellow Under Wing and others. They are also known as *Surface Caterpillars*, as during the day they usually hide in the upper surface of the soil or under shelter such as leaves, grass, or stones, but at night they come out and feed on the leaves or stems of succulent plants, more frequently on the latter. A common form of injury at this season is for the caterpillars to bite through the stems of succulent plants such as cabbages, especially those which have been newly planted out, but these pests also attack such crops as mangolds, turnips and potatoes. Young cabbage plants are rendered useless by these ravages, and the tops fall to the ground. Such damage is often found where ground is not properly cultivated, the presence of weeds having attracted the female moths to lay their eggs in this place. Where only a small number of plants is to be dealt with the simplest method of preventing further damage is to search the surface soil around the base of injured plant and discover the caterpillars. These vary in colour from a reddish brown to grey or grey-green. Further particulars are given in Leaflet No. 33. In both this instance and in other cases of soil pests much good may be done by regular hoeing.

Owing to the wet summer *Botrytis* in onion plants is likely to be prevalent, and every effort should be made to ensure that the plants are well dried off before storing. Thorough drying of root vegetables before storing is a point that should be emphasised, as many of the roots can only spread under damp conditions, while in a year like the present special attention should be paid to the drying off of potatoes as far as possible before they are pitted.

Autumn-sown onions should be examined very closely while in the seedling stage for traces of *Onion Smut*. This is a disease which as yet is uncommon in England, but is making its

appearance in various districts. It is a soil fungus, and attacks plants only when they are very young. The disease can then be detected, as grey streaks on the leaves and bulbs; later it breaks through as a black powder. Where found its presence should be reported at once to the Ministry.

In many cases runner beans or peas curled or having small dark-coloured spots or patches which sink below the general level of the surface. This is a sign of the *Bean Pod Canker*, and infected beans should not be used for seed, as the resulting crop would show the disease at an early stage of growth and be killed before the flowering season is reached. Full particulars of this disease are given in Leaflet No. 185.

Fruit.—At this time of the year fruit growers are often puzzled to account for the various markings upon fruit, more especially on apples, which are frequently spoiled for market purposes. The commonest of these markings, namely, those caused by apple scab, are fairly well known, and may be shown by dark or russety patches, or in extreme cases deep cuts and cracks. Markings that are not so well known are found in certain districts; these are caused by capsid bugs, and the *green apple capsid*, *Plesiocoris rugicollis*, punctures the leaves and fruit, and also the shoots of the apple. A full account of the insect and the damage it causes are given in Leaflet No. 319. It may here be stated, however, that the attacked apples are usually deformed; the skin shows rough, russety patches with scattered pits and pimples, indicating the position of the original punctures. As in the case of apple scab, really bad specimens are shapeless, and may have cracks extending deeply into the interior. The best way to control this pest is by spraying with nicotine and soft soap before the blossom bursts.

Brown Rot on plums and apples was mentioned in the notes in the July issue of this Journal. Owing to the wet weather the trouble became serious, and it is probable that there will be a large number of apples attacked by this disease. In such cases every effort should be made to remove and burn all diseased fruit, and where possible to cut out the spurs to which the fruit was attached, as such spurs are now known to be infected.

Among the plum trees, *Silver Leaf* should still be looked for, and trees which are showing a silvering of the leaves should be dealt with or marked if it is not possible to do more. Where only one portion of a tree is attacked it is usually sufficient to cut the diseased part away, but care should be taken that the branch is removed sufficiently far back that no mycelium or

spawn of the fungus is left in the tree. This can be detected by the absence of a brown stain in the wood. In any case it is far better to cut the branch back flush with the trunk. Where the trunk is infected it is preferable to remove the whole tree, and growers are reminded that under the Silver Leaf Order all dead wood of plum trees should be cut out and burnt before 1st April of each year. Silver Leaf chiefly attacks Victoria plums, but it also affects other stone fruits and apples, as well as certain shrubs, more especially the Portuguese laurel. Wherever it is found steps should be taken to cut out and burn diseased branches or trees.

It is during September that gooseberry shoots attacked by *American Gooseberry Mildew* are best removed. During the summer the mildew is seen as a white glistening substance on shoots and young leaves. This, however, by September has usually changed to a deep chocolate brown, and the resting spores are developed. During this month the resting spores commence to fall to the ground, and diseased tips should therefore be removed and burnt as soon as possible. By this time the wood is sufficiently ripe, and fresh growth will not take place. If the tipping is done too soon new shoots are formed, and these frequently become attacked with the white stage.

When cutting out the old raspberry canes care should be taken to remove and burn all rubbish, as the *Raspberry Moth* spends the winter in shelter afforded by the old canes, crevices of the supports, and in rubbish (See Leaflet No. 14.) Another raspberry pest which breeds on the old canes is *Hendersonia rubi*. This fungus attacks young canes during the summer, causing red or purplish patches of variable size to appear on the stem. These increase in size, and during the winter change to a dull grey or dingy white colour. When the bark has been killed on such patches the spores of the disease are produced and these infect young canes in the following season. It is necessary, therefore, that all old canes should be burnt, and any young diseased canes cut out and treated similarly.

In some districts *Apple Sucker* gives a great deal of trouble in the spring, the young larvæ getting into the blossom clusters and sucking the nutriment until the blossom appears as though it had been frosted. The adults are in the flying stage in September, and where the apples have been picked before the insects have laid their eggs it is possible to kill a large number of the pests by spraying. As at this date injury to the leaves is not of great importance, any insecticide, such as paraffin or

creosote emulsion, may be used. The presence of this tiny white fly can usually be detected readily by shaking the tree or branch. Further particulars are given in Leaflet No. 16.

Fruit growers should make preparations for grease banding their trees, and obtain the necessary materials. The reason for grease banding trees is that certain moths, chiefly the *Winter Moth*, the *Mottled Umber*, and the *March Moths*, have wingless females which have to climb the various trees before they can lay their eggs. Full particulars of these moths are given in Leaflet No. 4. The moths first appear above the ground about the end of September, and may appear any time during the next few months, according to soil and other conditions. If the grease on the bands is kept sticky the moths are caught and prevented from laying their eggs on the tips of the shoots. Every moth caught would probably lay several hundred eggs, which in due course would hatch out to the familiar green caterpillars which cause so much damage early in the year. Such bands are of no value in checking the *Codlin Moth*, but the hay bands recommended for this in a previous article (July, 1920, p. 378) should now be removed and burnt.

Cereals.—All cereals should be harvested by September, but it may be mentioned here that the *Gout Fly* or the *Ribbon-footed Corn-fly*, as it is also called, caused much damage this season to wheat and barley. The latest brood will lay its eggs on wild grasses, or on young wheat if this is near. In such cases wheat and barley should not be sown close to a previously infected field. The grass on the headlands should be kept down, and if wheat has to be sown near, the operation should be deferred as late as possible, so that the late brood of flies may find no young plants on which to lay their eggs.

General.—It cannot be too strongly urged that the collecting and burning of refuse in gardens and fields is the best possible preventive of further damage by different pests, since a great many of the common pests over-winter in the refuse heap and frequently find their way back on the land when the manure is distributed in the spring.

For the same reason infected food plants should not be given raw to animals, as in many cases the fungus spores pass unchanged through the animals and are replaced often on uninfected land with the dung. Many fields are infected with injurious soil-inhabiting fungi in this way.

Any of the Leaflets mentioned in this article may be obtained gratis and post free on application to the General Secretary, Ministry of Agriculture and Fisheries.

AGRICULTURAL RETURNS, 1920.

The following memorandum on the Agricultural Returns for 1920 was issued by the Ministry on 13th August :—

The preliminary tabulation of the Agricultural Returns shows that the total acreage under crops and grass in England and Wales on June 4th last was about 26,520,000 acres, a net decline on last year of 228,000 acres. Arable land accounts for 12,020,000

Crops.

acres, and permanent grass for 14,500,000 acres. The chief features of the returns are a reduction in the corn area and an increase in the area of clover and rotation grasses and green crops, together with large reductions in the number of cattle and sheep. In the case of pigs, there has been an increase.

The acreage under Wheat, 1,877,000 acres, is 344,000 acres less than in 1919, and only 70,000 acres above that of 1914. Oats are also being grown to a less extent than last year, the decrease being about 300,000 acres; but the total, 2,267,000 acres, is still 340,000 acres greater than in 1914. On the other hand the acreage of Barley has been increased by 127,000 acres to 1,637,000 acres, the highest acreage recorded since 1904. Beans occupy 258,000 acres, or nearly 10 per cent. less than last year, but the area under Peas has been slightly increased. The total area under Cereals and Pulse is 6,450,000 acres, or 540,000 acres less than 1919, but still some 325,000 acres above the average of the ten years 1910–1919.

Potatoes are being grown on a largely increased area, the total, 544,000 acres, being 70,000 acres greater than last year, and apart from 1918 is the largest on record. There is little change in the root crops.

Among other crops the most noticeable changes are the very large increase, 58 per cent., in the area devoted to vetches and tares, and the comparatively smaller but still large increases in the case of cabbage, kohlrabi, rape, lucerne and mustard. The area of sugar beet, about 3,000 acres, is about eight times as large as last year, whilst flax occupies 22,000 acres, or 4,000 acres more than in 1919. The acreage devoted to hops has risen by about 4,000 acres. The area of bare fallow, though less than last year, is still much above the pre-war average.

Clover and rotation grasses have been increased by 190,000 acres to 2,448,000 acres, of which about two-thirds, or 1,670,000 acres, were reserved for hay, this being an addition of 170,000 acres. The acreage of meadow hay was also increased, and the total area mown for hay this year was 6,080,000 acres as compared with 5,670,000 acres last year.

Horses used for agricultural purposes were reduced by 25,000, and there was some falling off in the number of foals, which were 7,000 less than in 1919.

Live Stock.

A serious decline is shown in the total number of cattle, the figures being only 5,547,000 against 6,194,000 in 1919, a reduction of more than 10 per cent. and the smallest number recorded since 1903. The decline is most pronounced in young cattle under one year old, the reduction in this class being nearly 300,000 or 25 per cent. The number of young cattle was exceptionally high during the War, but the serious reduction which has now taken place makes the number on farms on June 4th less than in any year since 1898, when the numbers of this class were first distinguished. The number of cattle from

one to two years old is also much less than last year, the reduction in this case being 160,000, or nearly 13 per cent. Cattle above two years old are slightly more numerous, while cows and heifers (in milk or in calf), though reduced by about 200,000 to 2,350,000, are 90,000 greater than in 1913, so that there is ample breeding stock from which to replenish the herds of the country.

Sheep have been largely reduced and the total now stands at only 13,880,000, or 1,750,000 less than a year earlier. This is by far the smallest total ever recorded, and is 5,340,000, or 29 per cent., below the average of the 10 years immediately before the War. All classes of sheep shared in the decline, the heaviest relative reduction being in those one year old and above.

Pigs, on the other hand, are being kept in larger numbers than in the last three years, the total, 1,995,000, being the highest since 1916. Sows kept for breeding increased to a relatively greater extent than other pigs, the addition being nearly 40,000, or about 15 per cent., so that the prospects of a further increase in the number of pigs appear to be good.

AGRICULTURAL RETURNS OF ENGLAND AND WALES, 1920.

PRELIMINARY STATEMENT for 1920, compiled from the Returns collected on the 4th June; and comparison with 1919.

CROPS.

DISTRIBUTION.	1920.		1919.		INCREASE.		DECREASE.	
	Acres.	Acres.	Acres.	Per Cent.	Acres.	Per Cent.	Acres.	Per Cent.
TOTAL ACREAGE under all CROPS and GRASS (a)	26,519,340	26,747,950	..	..	228,610	0.9	..	..
ARABLE LAND	12,090,110	12,308,870	..	..	218,760	2.3	..	..
PERMANENT GRASS (a) { For Hay	4,406,190	4,170,610	235,580	5.6	..	..	..	..
{ Not for Hay	10,093,110	10,268,670	..	..	175,460	1.7	..	..
{ TOTAL	14,499,300	14,439,080	60,150	0.4	..	..	..	..
Wheat .. { Autumn Sown	1,792,350	2,074,630	..	..	282,280	15.6	..	..
{ Spring Sown	84,650	146,570	..	..	61,920	72.8	..	..
{ TOTAL	1,877,000	2,221,200	..	..	344,200	18.5	..	..
Barley	1,636,770	1,509,720	127,050	8.4	..	..	..	..
Oats	2,267,100	2,564,330	..	..	297,230	13.6	..	..
Mixed Corn	148,440	142,610	5,780	4.1	..	..	..	..
Rye	96,470	106,520	..	..	10,050	9.4	..	..
Beans	257,640	284,630	..	..	26,990	9.5	..	..
Peas	165,180	163,480	1,640	1.0	..	..	..	..
Buckwheat	4,810	6,310	..	..	1,500	31.2	..	..
Potatoes	544,300	475,380	68,920	14.5	..	..	..	..
Turnips and Swedes	980,880	983,400	7,420	0.8	..	..	..	..
Mangold	385,780	396,050	..	..	10,270	2.6	..	..
Cabbage, Savoys, and Kale	62,080	51,680	10,500	20.4	..	..	..	..
Kohl-Rabi	11,180	9,630	1,580	15.9	..	..	..	..
Rape	100,440	92,320	7,210	7.7	..	..	..	..
Vetches or Tares	121,720	78,960	44,760	58.2	..	..	..	..
Lucerne	44,490	38,760	5,730	14.8	..	..	..	..
Mustard	71,860	63,280	8,580	13.6	..	..	..	..
Brussels Sprouts	12,650	11,920	730	6.1	..	..	..	..
Cauliflower or Broccoli	8,850	9,450	..	..	600	6.3	..	..
Carrots	9,640	11,380	..	..	1,740	18.3	..	..
Onions	4,480	6,960	..	..	2,480	55.0	..	..
Celery	4,300	4,150	150	3.6	..	..	..	..
Rhubarb	5,590	6,110	..	..	520	8.7	..	..
Sugar Beet	3,110	390	2,720	897.4	..	..	..	..
Chicory	340	270	70	25.9	..	..	..	..
Flax for Fibre	9,740	..	..	..	..	..	..	..
Linseed	12,730	18,460	4,010	31.7	..	..	..	..
Hops	20,760	16,740	4,020	24.0	..	..	..	..
Small Fruit	60,280	58,700	1,580	2.7	..	..	..	..
CLOVER and ROTATION { For Hay	1,574,080	1,501,380	172,770	11.5	..	..	..	..
{ Not for Hay	774,880	787,180	17,100	2.3	..	..	..	..
{ TOTAL	2,348,960	2,288,560	160,400	6.4	..	..	..	..
OTHER CROPS	67,110	68,450	..	..	1,340	2.0	..	..
BARE FALLOW	506,200	620,440	..	..	114,240	22.9	..	..

LIVE STOCK.

	No.	No.	No.	Per Cent.	No.	Per Cent.
Horses used for Agricultural purposes (including Mares for Breeding)	789,080	814,300	..	..	28,140	3.1
Unbroken Horses (including Stallions)	..	..	..	..	..	..
One year and above	235,700	230,880	4,870	2.1	..	..
Under one year	97,340	104,000	..	..	6,860	6.4
Other Horses	243,840	287,790	6,050	2.5	..	..
TOTAL OF HORSES	1,266,940	1,336,820	..	..	20,880	1.6
Cows and Heifers in Milk	1,827,580	1,943,670	..	..	116,110	6.0
Cows in Calf, but not in Milk	242,880	292,290	..	..	49,400	16.9
Heifers in Calf	222,400	317,530	..	..	35,130	11.1
Other Cattle:—Two years and above	1,178,780	1,167,080	11,090	0.9	..	..
" " One year and under two	1,108,840	1,271,390	..	..	162,550	15.6
" " Under one year	907,050	1,202,580	..	..	295,530	24.6
TOTAL OF CATTLE	5,546,900	6,194,540	..	..	647,640	10.6
Ewes kept for Breeding	5,107,940	5,764,300	..	..	656,360	11.4
Other Sheep:—One year and above	3,009,550	3,558,040	..	..	558,190	15.6
" " Under one year	5,261,180	5,791,970	..	..	530,790	9.2
TOTAL OF SHEEP	13,378,670	15,114,310	..	..	1,745,340	11.6
Pigs kept for Breeding	289,500	250,750	38,750	15.5	..	..
Other Pigs	1,705,240	1,547,720	157,520	10.2	..	..
TOTAL OF PIGS	1,994,740	1,798,470	196,270	10.9	..	..

(a) Excluding Mountain and Heath Land used for grazing.

ACREAGE OF HOPS.—The following Preliminary Statement compiled from the Returns collected on the 4th June, 1920, showing the ACREAGE under Hops in each COUNTY OF ENGLAND in which Hops were grown, with a COMPARATIVE STATEMENT for the Years 1919 and 1918, was issued by the Ministry on 14th August:—

COUNTIES, &c.	1920	1919	1918
	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>
KENT	East	2,530	2,370
	Mid	3,650	3,340
	Weald	4,380	4,030
	Total, Kent ...	10,560	9,740
HANTS	820	760	720
HEREFORD	2,990	2,420	2,330
SURREY	170	180	190
SUSSEX	1,790	1,410	1,310
WORCESTER	1,680	1,370	1,330
OTHER COUNTIES	60	50	50
TOTAL	20,760	16,750	15,670

NOTICES OF BOOKS.

National Council of Social Service—Monthly Bulletin.—(London: P. S. King & Son, Ltd., Orchard House, 2 & 4, Great Smith Street, Westminster, S.W.1, Price 3d.) With the object of being helpful to the ordinary citizen who is giving some form of social service, Number 1 of this series of Monthly Bulletins makes its appearance. It may be hoped that it will achieve its object. In an editorial foreword it is stated that "A wider conception of the State, as an association of citizens united for the common purpose of securing the fullest and freest life for all, has secured general recognition during the War, and has resulted in the acceptance by the Government of wider responsibilities for the care and welfare of the people."

Among the varied contents of the Bulletin's dozen pages is an article on "The Future Provision of Medical Services" which explains the re-organisation scheme outlined in the Interim Report of the Consultative Council on Medical and Allied Services, Ministry of Health. Under the title "Workers in Council" the aims of the National Council, which was formed in March, 1919, are set out. These include a survey of the whole local field of work, the prevention of overlapping and the development of co-operation in aim and effort. "Urban Notes" and "Rural Notes" describe the growth of the movement in their respective districts. The Council has a special Rural Department, of which Sir Henry Rew is Chairman, which comprises representatives of the National Farmers' Union, the Village Clubs' Association, the Women's Institutes and other organisations concerned with rural development. The information under the titles "New Legislation and Administrative Circulars"; "Bills before Parliament"; "Government Reports"; and "Some New Books," cannot fail to be of great interest to social workers. The Bulletin will keep them well abreast of the ever growing movements of progress.

Handbooks of Information on Social Service are also issued by the National Council of Social Service. The first of these, entitled "Public Services," has recently been published for the Council by P. S. King & Son, Ltd., Orchard House, 2 & 4, Great Smith Street, Westminster, S.W.1, Price 2/- net. Originally issued as a pamphlet by the Joint Committee on Social Service in 1917, this Handbook appears to have proved of practical value, 14,000 copies having been issued. Revised and brought up to date with the assistance of the Government Departments concerned, the second edition of the Handbook will be of even greater service. The 96 pages are divided into 8 chapters dealing with Public Health, National Health Insurance, Poor Law, Old Age Pensions, Education, Industry and Employment, Administration of Justice and War Pensions (Allowances and Medical Services). Used in conjunction with the Monthly Bulletin, in which changes in administration are recorded, the social service worker has the latest information at hand. A comprehensive index adds to its usefulness.

Erratum.—In the issue of this Journal for July, p. 393, it was in error stated that the Journal of the British Dairy Farmers' Association is published by McCorquodale & Co., who are the printers of the publication. The publishers are the British Dairy Farmers' Association, 28, Russell Square, W.C.1.

QUESTIONS IN PARLIAMENT.

Farming Operations by Agricultural Executive Committees.

—In reply to a question by Mr. E. Wood, the Parliamentary Secretary to the Ministry stated that an account of the farming operations undertaken by Agricultural Executive Committees on land of which possession was taken under the Defence of the Realm Regulations on the ground that it had not been properly cultivated had been prepared for the period from 1st April, 1917, to 30th September, 1919, which showed that the total payments and liabilities amounted to £653,890 and the total receipts and assets to £552,989, leaving a deficit of £100,901. The total area of which possession was taken amounted to 64,000 acres, but the Committees had withdrawn from possession of a considerable proportion, and the area which was still being farmed by the Committees amounted to approximately 20,000 acres. Much of the work of the Committees consisted of reclaiming practically derelict land, and in such cases a heavy initial outlay had to be incurred which could not be recouped in full in the first two or three years. (10th August, 1920.)

Double Sheep-dipping Order.—Captain Bowyer asked the Parliamentary Secretary to the Ministry whether he was aware that an order was issued in July for Leicestershire and Northamptonshire that all sheep were to be dipped twice within 14 days; that as a result of this order being carried out over 100 sheep had died; who was responsible for this order and from whom damages should properly be claimed; and whether he would cause the whole question of these sheep-dipping orders to be investigated so that at least sufficient notice should be given to prevent future orders overlapping, and to enable those affected to protest where necessary?

In answer, the Parliamentary Secretary stated that the reply to the first part of the question was in the affirmative, except that the order was issued on 26th June. As regards the second part a certain number of losses attributed to double dipping had been reported to the Ministry, but full details were not yet available. The double dipping order imposed in Leicestershire and Northamptonshire, according to which sheep have to be dipped twice within a period of 14 days in a dip approved by the Ministry, was one of a number of orders applied to various parts of England, Scotland and Wales in pursuance of the Ministry's policy for the eradication of sheep scab. The reports which had reached the Ministry indicated that the losses in question had been due to the use of a poisonous dip for the second dipping. In this connection it was expected that the advice given by the Ministry on the subject of the use of sheep dips, especially as regards the choice of a non-poisonous dip for the second dipping, would have prevented the losses in question. (11th August, 1920.)

Small Holdings and Allotments (Notices to Quit).—Sir K. Wood asked the Parliamentary Secretary to the Ministry whether he was aware that allotment holders in large numbers continue to receive notices to quit; that in many cases the notice was so short as 7 and 14 days; that the evictions of allotment holders would involve the loss of a considerable amount of food; and whether, in the public interest and in view of the need for increased production of food, he would take steps to remove the anxiety now existing among allotment holders by securing an Amendment of the legal provisions

and the regulations under the Defence of the Realm Act to provide that no notice should be valid which purports to terminate tenancies of allotments at less than six months, or some other reasonable period?

In reply the Parliamentary Secretary stated that he was aware that a certain number of allotment holders receive notices to quit from time to time, and that when, as was usually the case, the land was immediately required for housing or building the notice to quit was necessarily short, as every effort is made to retain the land under cultivation until the latest possible date. Although the need for increased food production was still urgent, he was of opinion that in the general public interest the retention of land as allotments could not be permitted to restrict the development of a town or to prevent the erection of houses, factories, works, etc. For this reason he regretted that it is not possible to adopt the suggestion contained in the last paragraph of the question. (23rd July, 1920).

Small Holdings.—In reply to a question by Mr. Cantley, the Parliamentary Secretary to the Ministry stated that the number of agricultural holdings exceeding 1 and not exceeding 50 acres in England and Wales in 1907, and in each succeeding year since that date was:—

Year.		Number.	Year.		Number.
1907	...	289,093	1914	...	291,722
1908	...	287,176	1915	...	289,689
1909	...	288,011	1916	...	284,153
1910	...	288,802	1917	...	278,556
1911	...	292,488	1918	...	275,334
1912	...	292,720	1919	...	272,568
1913	...	292,446			

(23rd July, 1920.)

Ecclesiastical Tithe Rentcharge (Rates) Act, 1920.—This Act received the Royal Assent on the 4th August. The Ministry of Health has issued to Town Councils, Urban District Councils, and Overseers, a circular letter enclosing copies of a memorandum with respect to the provisions of the Act and of the Order of the Minister of Health prescribing a form of statutory declaration as to income to be made by any incumbent who desires to claim under the Act exemption from rates on the ground that the total income arising from the benefice does not exceed £300, or an abatement on the ground that it is between £300 and £500.

The Circular and the Memorandum, Order and Regulations referred to in it will be placed on sale, and copies may shortly be obtained, either directly or through any bookseller, from His Majesty's Stationery Office at the following addresses:—Imperial House, Kingsway, London, W.C.2, 28, Abingdon Street, London, S.W.1, 37, Peter Street, Manchester, and 1, St. Andrew's Crescent, Cardiff.

Forms of statutory declaration for the use of incumbents will no doubt be printed by various local government publishers and will shortly be purchasable from them. It should, however, be clearly understood that they will not be supplied by His Majesty's Stationery Office or any other Government Department.

Rabies.—The Ministry of Agriculture and Fisheries announced on 17th August that, owing to an outbreak of Rabies at Wilton, near Salisbury, it had been found necessary to issue an Order imposing Muzzling Restrictions in what is roughly a twenty mile area surrounding that place, and embracing parts of the Counties of Wilts, Hants and Dorset. The boundaries of this Muzzling Area are, roughly, Bournemouth in the South, Winchester in the East, Wroughton in the North, and a point a little west of Maiden Bradley in the West. These boundaries are, however, only approximate, and in all cases of doubt application should be made to the local Police or to the Ministry of Agriculture.

The effect of this Order is that no dog can be moved out of the Muzzling Area except by Licence of the Ministry, the chief condition of which is quarantine on veterinary premises for a period of six months.

The Area to which the Muzzling and Movement Restrictions apply did not then include the Boroughs of Winchester, Southampton, Leamington, Christchurch, Bournemouth and Poole, or any other of the South Coast watering places.

On 21st August it was announced that owing to the confirmation of a further case of Rabies in Marlborough, it had been found necessary to enlarge the Northern part of the original Muzzling Area which was announced on the 17th inst. This means that the boundaries of the Muzzling Area in Wilts, Dorset, Hants and Berkshire were roughly as follows:—Bournemouth in the South, points a little West of Newbury and Winchester in the East, roughly about three miles North of Swindon in the North, and points slightly East of Cluppenham and West of Maiden Bradley in the West.

In a further notice of 24th August it was announced that a third case of Rabies had been confirmed at Salisbury, about three miles from the scene of the first case at Wilton. The Ministry had in consequence applied special regulations for the control of dogs to an Inner or Dangerous Area having a radius of about five miles round Wilton and Salisbury, which is in turn surrounded by the larger Muzzling Area declared on the 16th August and extended on the 21st August. In this Inner Area all dogs while in a public place are required to be led as well as muzzled.

No dog is allowed to be moved out of the Inner Dangerous Area, whether to a destination in the surrounding Muzzling Area or elsewhere, except by Licence of the Ministry of Agriculture, which requires the quarantine of the dog for six months on the premises of a veterinary surgeon approved by the Ministry.

Experimental Farm to Improve the Cultivation of Maize.—

The Ministry is informed that a decree, dated 6th May, 1920, has been made by the Italian Government, which provides for the establishment at Bergamo of an experimental farm for the purpose of improving the cultivation of maize.

International Dairy Exhibition at Buenos Aires.—In the *Board of Trade Journal* for 12th August, 1920, it is stated that the Commercial Secretary to H.M. Legation at Buenos Aires intimates that it is intended to hold an International Exhibition of Dairy Stock, Products, Machinery and Implements at Palermo (Buenos Aires) in May, 1921. The programme is being compiled, and it is expected that copies will be available shortly, but in the meantime the Argentine Rural Society is causing the announcement of the

intention to hold the Exhibition to be circulated among live stock breeders, dairy farmers and manufacturers.

Wet Weather and Animal Disease.—The Ministry of Agriculture and Fisheries desires to draw the attention of farmers and others to the fact that the abnormally wet season may be followed by serious parasitic infection of animals and to remind all concerned that leaflets on internal and other parasitic diseases of animals can be obtained free of charge on application to the Ministry at 3, St. James's Square, London, S.W.1.

Leaflets issued by the Ministry.—Since the date of the list given on page 497 of the issue of last month's *Journal* the following leaflets have been issued in the *Permanent Series* :—

- No. 349.—Methods of Obtaining Strong Stocks of Bees for Over-Wintering. (Formerly issued as Food Production Leaflet No. 55.)
- „ 353.—Winter Oats. (Formerly issued as Food Production Leaflet No. 22.)
- „ 354.—Jam-making when Sugar is Scarce. (Formerly issued as Food Production Leaflet No. 4.) (See page 512 of this issue.)

In addition, the information in the following leaflets has been revised and brought up to date :—

- No. 20.—The Magpie Moth.
- „ 231.—Cheese-making for Small Holders.
- „ 276.—Commercial Mushroom Cultivation.
- „ 324.—Buttermilk Cheese.

ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous.

- Netherlands Ministry of Agriculture, Industry and Commerce.*—A General View of the Netherlands. No. 1. Agriculture and Cattle Breeding, and State Measures Furthering these Branches of Activity (210 pp.). Hague, 1915. [63 6(492)]
- Netherlands Ministry of Agriculture, Industry and Commerce.*—A General View of the Netherlands. No. II. Nurseries (32 pp.). Hague, 1915. [63 5(492)]
- University of Leeds and Yorkshire, Council for Agricultural Education*—No 73 :—Composition, Nutritive and Manurial Values of Farm Foods. [4th Revision] (2 pp). Leeds, 1919 [63.604.]
- India, Imperial Department of Agriculture*—Memoir No. 6, Vol. V., Chemical Series—Absorption of Lime by Soils (16 pp.) Pusa, 1919. 2s. [63 113(54)]
- Russell, E J.*—Regional Factors in Agriculture (7 pp.). (Reprinted from the Geographical Teacher, No 56). [63(04).]
- Australian Imperial Force, Education Service.*—A.I.F. Land Book No 11.—Tropical Agriculture (50 pp). London: A.I.F. Administrative Headquarters, 1919. 1s. [63(024).]

Field Crops.

- Union of South Africa, Ministry of Agriculture*—Report of the Departmental Committee on Wheat-growing, Appointed to Enquire into the Conditions of Wheat-growing in the Union (140 pp). Cape Town: Cape Times (U G 42-19), 1919 6s. 6d. [63 311(06) (68).]
- South Australia, Department of Agriculture.*—Bull. 127 :—Fodder Crops on Reclaimed Swamp Lands (16 pp) Adelaide, 1919. [63 142(942)]
- South Australia, Department of Agriculture.*—Bull. 128 :—Ensilage, Its Manufacture and Use (19 pp) Adelaide, 1919. [63 1985]

Plant Diseases.

- Taubenhaus, J J*—A Contribution to Our Knowledge of Silver Scurf (*Spondylocladum A. roviensis* Harz) of the White Potato (12 pp.). (Reprinted from Memoirs of the New York Botanical Garden, 6 pp., 549 560, Aug. 1916) [63 24-33, 63 512(04).]
- Sweet Pea Diseases and their Control (13 pp). (Reprinted from the Trans. of the Massachusetts Horticultural Soc., 1916, Part I.), 1916. [63 62]
- Royal Society*—No 6—Reports of the Grain Pests (War) Committee (51 pp) London Harrison & Sons, 1920 2s. [63 27-31(06).]
- Royal Society*—No 7—Reports of the Grain Pests (War) Committee (52 pp). London Harrison & Sons, 1920. 2s. [63 27-31(06)]
- Western Australia, Department of Agriculture*—Bull 69—Take-All, Septoria, Rust and Wheat-Mildew Practical Methods of Control (27 pp) Perth, 1920 [63 24-31]
- U.S., Department of Agriculture*—Farmers' Bull. 1083—The Hessian Fly, and How to Prevent Losses from It (16 pp). Washington, 1920 [63.27-31(73).]

Horticulture.

- Steward, R.*—Practical Hardy Fruit Culture (216 pp.). London: Swarthmore Press, 1920. 6s. net. [63 41(02).]
- Abbey, Rev. R.*—Our Orchards. Letters to the "East Anglian Daily Times," 1892-1920, with Notes (35 pp). Earl Soham: The Editor, 1920. 1s. [63.41(04).]
- Dillistone, G.*—The Planning and Planting of Little Gardens (134 pp.). London: Offices of "Country Life," 1920, 6s. net. [63.5(02).]

Live Stock.

- Rozéray, A.*—L'Avenir de Quelques Bons Types d'Animaux Français sur Différents Points du Globe (87 pp.). Niort: Th. Mercier, 1919. [63 602.]
- Dubois, Général.*—La Crise du Demi-Sang Français. Evolution nécessaire (121 pp.). Paris: H. Charles-Lavauzelle. [63.613(44).]

- Tuxen, S. C. A.*—Husdyrbruget Den Almindelige Del. (8 Udgave), (288 pp.). Kjobenhavn : Gyldendalske Boghandel, 1906. Kr. 8.75. [63.6.]
- Thompson, G. F.*—A Manual of Angora Goat Raising, with a Chapter on Milch Goats (236 pp.). Chicago : American Sheep Breeder Co. Press, 1903. [63.638.]
- Leyder, J.*—Le Cheval Belge sa caractéristique et les conditions de son élevage (128 pp.). Bruxelles : Alfred Castaigne, 1905. [63.613(498).]
- Union of South Africa, Department of Agriculture.*—Bull. 2 :—Pigs and Piggeries. Pt. I. Breeding, Feeding and Management. Pt. II. The Design and Construction of Piggeries (55 pp.). Pretoria, 1919. 3d. [63.64(04).]

Veterinary Science.

- Marshall, F. H. A. and Wood, T. B.*—Physiology of Farm Animals, Part I., General (204 pp.). Cambridge : University Press, 1920, 16s. net. [619(02).]
- Canada, Department of Agriculture*—Scientific Series No. 27 :—Warble Flies. *Hypoderma Lineatum*, Villers, and *Hypoderma Bovis*, De Geer. (24 pp.). Ottawa, 1919. [619.2(f), 63.62.]
- Regnér, G.*—Experiments with Conjunctival and Intracutaneous Tuberculin Tests (81 pp.). Edinburgh : W. & A. K. Johnston, 1920. [614.5.]

Economics.

- Committee on the Increase of Rent and Mortgage Interest (War Restrictions) Acts.*—Report of the Committee (14 pp.). London : H.M. Stationery Office (Cmd 658), 1920, 2d. net. [333.5, 333.6.]
- Ministry of Labour (Intelligence and Statistics Dept.).*—Report on Profit-Sharing and Labour Co-Partnership in the United Kingdom (244 pp.). London : H.M. Stationery Office (Cmd. 544), 1920, 1s. net. [831.]
- Farmers' Club Journal.*—Part 3 :—Land Tenure (63 pp.). London : Farmers' Club, 2. Whitehall Court. S.W.1. 1920, 6d. [333.5.]
- Royal Commission on the Income Tax.*—Report of the Commission (186 pp.). London : H.M. Stationery Office (Cmd. 615), 1920. 3s. net. [336.24(06)].
- Ministry of Food*—First Report of the Departmental Committee on the Wholesale Food Markets of London, 23rd February, 1920 (8 pp.). London : H.M. Stationery Office (Cmd. 634), 1920. 1d. net. [381.1.]

Dairying and Food, General.

- Royal Agricultural Society of England.*—Report of the Steward of Dairying, Cardiff Show, 1919 (19 pp.). London : The Society, 16, Bedford Square, W.C.1., 1919. 6d. [63.70(06).]
- Tisdale, C. W. W., and Jones, J.*—Butter and Cheese (142 pp.). London : Sir Isaac Pitman & Sons, 1920. 2s. 6d. net. [63.70(02).]
- Macgregor, A. S.*—Milk Supply in Copenhagen (87 pp.). Edinburgh : Scott & Ferguson & Burness & Co., 1890. 1s. [63.71(489).]
- Kjeldsen, C. M.*—Malkekvaegets Fodring, Røgt og Pleje (78 pp.). Kobenhavn : Gyldendalske Boghandel, 1915. Kr. 1.00. [63.711.]

Birds, Poultry and Bees.

- South Australia, Department of Agriculture.*—Fertilization of Hens' Eggs. A Record of Experimental Work in Deciding the Duration of the Influence of the Male Bird (6 pp.). Adelaide, n.d. [63.651.]
- Geary, H.*—The Beekeepers' Vade-Mecum (202 pp.). London : Stanley Paul & Co., 1920. 2s. 6d. net. [63.81 (02).]
- N.S.W., Department of Agriculture.*—Farmers' Bull. 129 :—The Beginner in Bee Culture (19 pp.). Sydney, 1920. [63.81(04).]

Forestry.

- Cambridge Forestry Association.*—The Archives of the Association, 1919 (12 pp.). Cambridge : University of Cambridge School of Forestry, 1919. [63.49(06).]

THE JOURNAL OF THE MINISTRY OF AGRICULTURE

Vol. XXVII. No. 7.

OCTOBER, 1920.

NOTES FOR THE MONTH.

IN view of the assertion often made by farmers that their land is not suitable for wheat growing, it is instructive to review the climatic and soil conditions under which the crop flourishes. The range of climatic conditions is greater than with most other food plants, extending from within the tropics to the northern limits of the temperate zone. Growth throughout such a wide range of latitude and on such widely different types of soil is, of course, possible, owing to the large number of species and varieties cultivated, and it shows that wheat is a wonderfully hardy and adaptable plant.

So far as Great Britain is concerned, wheat growing is confined mainly to the Southern, Midland and Eastern Counties of England and to the eastern fringe of Scotland, the reason being that these regions are, as a rule, best suited to the wheat commonly grown in this country and to the systems of farming in which wheat occupies a place otherwise difficult to fill. In other regions other cereals are better adapted to the farming systems in vogue or give a better return on outlay. Experience of the war years, however, discloses the fact that wheat may often be successfully grown in the most unexpected places.

To give the best results wheat requires a fairly high summer temperature and a moderate annual rainfall. It will thrive on almost any soil, even the light "heath" land of Norfolk, provided that the requisite "condition" is first built up and maintained. Excellent crops may be grown on the heaviest and most intractable of clays if the drainage be adequate and

the cultivation skilful. Wheat is specially favoured on heavy land because it can be sown in autumn when the requisite tilth is usually more easily secured than is the case later for spring-sown crops. Strong loams are admirably adapted for wheat in regions of comparatively low summer rainfall. In wetter districts light soils, if in good condition, will answer the purpose equally. The main considerations from the farmers' standpoint seem to be such conditions of soil and fertility as will ensure steady growth until the plant is thoroughly established. Thereafter the crop is much less dependent on rainfall than either oats or barley.

Treatment of different Types of Soil.—Heavy soils are improved for wheat growing by drainage (both under-draining and, when necessary, surface draining) and by liming: by half fallows and in certain cases by summer fallows. The requisite plant food can be supplied either in the form of artificial manures applied directly to the crop or in the form of crop and manurial residues incidental to rotational cropping.

In the case of the lightest soils, fertility and the requisite "body" must be built up by the use of manures applied to green crops for folding or ploughing in, by the growth of clover and other leguminous crops, or by a system of short-term leys.

Medium soils must likewise be well farmed, for wheat occupies the ground for a relatively long period and requires adequate and uniform sustenance throughout its life.

Varieties.—Although many, if not most, of the varieties commonly grown in this country are about equally well suited to the generality of conditions encountered, a few may be worth noting in regard to their adaptability. On cold and heavy soils in poor physical condition, varieties of the Rivet type usually do as well as any. The grain is of rather poor quality, but the straw is long, coarse and tough and well suited to withstand the most adverse weather conditions. Rivet wheat, however, must be sown early, and is not suited to late districts.

For general average conditions Victor, Wilhelmina, Little Joss, Browick, Squarehead's Master and similar varieties are generally dependable.

On very rich soils Yeoman or Swedish Iron may be safely trusted. They will stand up well and thresh well. Yeoman gives a better quality grain.

For light soils probably no variety is more suitable than Little Joss.

FARMERS who contemplate extending their wheat area should arrange, if possible, not to reduce the acreage under

Winter Oats. oats, for this grain may be just as useful as wheat, and the straw is of value as fodder. In many districts, particularly the south of England, the Frit-fly, sometimes called "bottling," has made spring oats a precarious crop. It is, therefore, well to sow the winter grain, or Black Oats, about the end of March, as these are more reliable than the commoner spring sorts, especially on grass land just ploughed and in districts troubled by the Frit-fly. Winter-sown oats are less liable to attack by this pest, and are worthy of increased attention. They are also better adapted to land badly infested with charlock.

The three varieties of winter oats generally favoured are Winter Grey or Dun Oat, Winter Black and Bountiful Black Oat. Experience must guide choice, for all may grow equally well in one district, but a particular variety may happen to be in keener local demand. The Black varieties are somewhat stronger in straw than the Grey, and are preferable on land subject to "lodging." The Winter Black Oat is more liable to shed its seed, and should be cut before it is dead ripe. It does not give such a palatable straw as the finer spring varieties, but stock will readily eat it chaffed and mixed with cake or meal. Winter oats suit a wide range of soils, and can be grown successfully on land too poor or too light for wheat. They can also be taken for a second crop on clean land. They are less hardy than winter wheat or barley, and must be sown early, preferably in September, so as to get well established before the cold weather. "Bountiful" is the most delicate of the three varieties, and should be reserved for the milder districts: it requires a somewhat richer land than the others. In preparing the soil for winter oats, it is well to leave it somewhat rough as a protection against cold winds, and in certain ground harrowing may be omitted after drilling. Clean land is essential, as weeds may seriously reduce the crop. Among troublesome weeds, the Brome Grass is noteworthy, and purchasers should see that their seed oats have been carefully cleaned. Winter oats are best suited to the warmer southern counties, and are generally fit for cutting about 10 days before other corn crops.

* * * * *

WOMEN'S Institutes have from the outset been based on the principle of self-government. During the short period when Institutes were still only finding their way as a national movement, assistance was given by the Ministry.

**Schools for
Women's Institute
Organisers.**

The Women's Branch of the Ministry was made responsible, for a period of about eighteen months, for the development of the organisation throughout the country. This, however, was only a temporary arrangement, and was intended to be so, from the outset, as it was obvious that the permanent strength of the movement rested upon the basic principle of self-government. When the Women's Branch was no longer responsible for propaganda work, the Ministry, who recognised the value of Women's Institutes to the rural life of the country, decided that it would be well to secure a high standard of work among those responsible for the further development of the movement. Treasury sanction was, therefore, obtained to form two schools of instruction for Women's Institute organisers, which should be held, if possible, at "University" centres and last for at least a fortnight. By this arrangement, Organisers are given an opportunity of meeting the leading men and women at the Universities and of learning from them. Short as the sessions must be, such schools will undoubtedly quicken interest in the subjects discussed, while the lecturers will be able directly to encourage and suggest further lines of study.

Of the organisers employed by the National Federation of Women's Institutes, a small number are paid, full-time officers, who explain Women's Institute work in the villages, organise new Institutes, and perform much valuable after-care work. In addition to paid organisers, a considerable number of women who have knowledge of Women's Institute principles and methods and who can give a certain portion of their time to develop the movement in their own counties, have been appointed voluntary organisers to the Federation. From both these classes, 40 students have been selected for the Ministry's Schools of Instruction. The first School opened on 20th September and closes on 2nd October, at Oxford, where Professor Somerville and Mr. Ashby of the School of Rural Economy gave every facility, both as regards lecturers and accommodation. The second school will be open at the University College of Wales, Aberystwyth, from 18th to 30th October. Principal Davies and his staff are taking active interest and are giving generous assistance in the school.

The main subjects dealt with in these schools are connected, in the first place, with agriculture, in its historical and more general aspects; and, in the second place, with the facts and possibilities of local government, so that village women may understand more of what is really available for the life of the community through the county, district and parish councils. Other important subjects are village recreations, home-making and hygiene, and the principles and methods of voluntary organisation, with special reference to Women's Institutes. Thanks to the response given by the authorities at both Oxford and Aberystwyth, some of the best University lecturers have been secured—Mr. Ashby, Mr. C. S. Orwin and Mr. C. G. T. Morison at Oxford, and Professor E. A. Lewis, Mr J. Morgan Rees, Mr. Sidney Herbert, Dr. R. O. Morris, Mr. Bryner Jones and Professor Abel Jones at Aberystwyth. In addition, Dr. Walford Davies is giving a lecture at the Aberystwyth School on "Music in the Villages"; while at Oxford the students will have the advantage of hearing Mr. Cecil Sharp on "The Purpose of Art," and Miss Avice Trench on "Home-making and Hygiene." The Ministry is also fortunate in having secured the services of Miss Grace Hadow, Vice-Chairman of the National Federation, to arrange lectures at both schools on "Voluntary Organisation," and especially the organisation of the Women's Institute movement itself.

The lectures—never more than two each day—will be followed by an hour's open discussion.

A number of outside events have been planned. These include visits to the University Farm at Oxford and the new Plant Breeding Station at Aberystwyth, as well as functions of a more social character to places of interest in the University and neighbourhood.

At Aberystwyth, the students will have the opportunity of attending Dr. Walford Davies's annual musical festival and his Thursday evening concerts at the University. Dr. Lund, of the Department of Agriculture, Washington, will give a demonstration at Oxford on the American way of preserving food in the home, and will speak on agricultural extension work in the United States at an open meeting. The Council of Barnett House, Oxford, is placing the library of that Society at the disposal of the students, and a list of books and pamphlets dealing with rural questions will be available.

Arrangements have been made for the organisers attending both schools to lodge in one house, and not the least value

of the schools will be the opportunity thus afforded for those attending the different lectures to meet together in a friendly manner and discuss the subjects of the lectures and the future of the movement.

Shorthand notes of lectures and discussions will be taken, from which a report will be made, and will doubtless prove of great interest and value to all workers in the Women's Institute movement as well as to others interested in the improvement of rural life.

MANY acres of orchard land in England and Wales have fallen into a deplorable state of decay. The causes of unprofitableness are many. Some are beyond

Renovation of Neglected Orchards. remedy, but others are preventable, and fruit-growers would be serving their own interests as well as the interests of the country if they made a serious attempt to bring neglected orchards back to productivity; but the work must be undertaken with judgment. It is not commercially sound to restore plantations and orchards which have become unprofitable owing to extreme old age, stunted growth, or severe damage caused by live stock, careless staking, or grease-banding without paper. On the other hand, many dilapidated plantations and orchards may be restored to fruitfulness if their unsatisfactory state is due to lack of pruning, proper cultivation, or neglect to control insect and fungus pests. Even if the trees are unsuited to the locality, or bear fruit of poor market quality, much may be done, and done speedily, by judicious top-grafting. The results of renovation may become apparent even so early as the year following the first application of remedial measures, but as a general rule careful treatment is required for several seasons before badly neglected or otherwise unfruitful trees are brought back to full bearing.

Renovation falls into two sets of operations. These are:—

- (1) Thinning overcrowded plantations by judicious pruning, top-grafting, manuring and general cultivation.
- (2) Cleaning the trees and controlling insect and fungus pests by winter washing and summer spraying.

To remedy overcrowding, alternate trees should first be "cut-in" hard each year, and, later, after several seasons have elapsed, "grubbed up" to give the permanent trees sufficient room for growth. Plantations and orchards which have

become badly overcrowded should receive very drastic treatment. Nothing less than the removal of alternate trees will be of permanent value. Many orchards and plantations have lapsed owing to the entire neglect of winter pruning. There is a great tendency to treat "Standards," in particular, as ordinary shade trees, and to assume that they are quite capable of looking after themselves. "Standards" and "Half-Standards," it is true, cannot be dwarfed or forced in the same way as cordon and bush trees, and in these cases, therefore, spur-pruning is unsuitable. The proper method is to adopt the simple system of thinning the heads. This is done by removing all crossing branches and strong growths arising from the centre of the tree and shortening those branches which tend to become spindly and unable to bear a heavy crop without breaking. The head then remains well balanced. It can be effectively sprayed, while sunlight and air can penetrate to all parts, so that the fruit colours and the wood ripens satisfactorily. The heads of trees that have not been winter-pruned for several years are usually mere thickets, and, therefore, contain practically no fruiting wood except on the outside. Apples which have been thus neglected should be top-grafted with a strong growing variety, but pears, plums, cherries and apples not badly overcrowded should be very carefully thinned, the operation extending over several years, so that there will be no risk of killing the tree by a very severe check.

Insufficient manuring is a common cause of unfruitfulness, and is most difficult to remedy. It occurs very frequently in grass orchards. Poverty-stricken trees are easily recognised by their light-yellow leaves, small annual growth, and the "unkind" hide-bound appearance of bark, trunk and branches. While grass may in certain cases impair the health of young trees, it will serve, in the case of older plantations on strong land, to check excessive growth, and will promote heavy fruiting. Grass should always be kept closely grazed, especially with sheep fed on meal, and a dressing of basic slag at the rate of 5-10 cwt. per acre will give good results on heavy soils. This should be applied every four or five years. Ground lime also has a good effect. Special attention must be paid to the winter washing of fruit trees. Caustic washes are most satisfactory for trees in a thoroughly bad condition. Lime sulphur washes may be used between November and February, and lime washes, applied usually in early spring, just before the buds break, are effective in destroying insect pests.

THE Seeds Act, 1920, received Royal Assent on the 16th August, but does not come into operation until the 1st August, 1921. The object of delaying the date on which the Act comes into force is to allow the Seed Trade ample time to study the regulations which will in future govern the sale of seeds in this country.

The passing of this Act makes permanent one of the farthest-reaching minor reforms in the interests of good agriculture—that effected by the Testing of Seeds Order, a measure passed under the Defence of the Realm Regulations. The Testing of Seeds Order, 1917, which came into operation on the 1st January, 1918, brought the United Kingdom into line with the Continent, America and the Colonies, where for a number of years various regulations have been in force for the purpose of preventing the sale of seeds of low vitality and seeds containing a dangerous proportion of injurious weeds. In 1816 regulations were in force in Switzerland which enabled Government Inspectors to enter any seed shop or warehouse for the purpose of examining the seeds offered for sale. Cases of fraud were suitably dealt with. In 1871, E. Müller Holst initiated a system of control of seeds in Denmark and founded his seed testing office.* Then followed the setting up of various methods of seed control in Holland, Hungary, Germany, the United States of America and a number of the British colonies. The first official Seed Testing Station in the United Kingdom was established in Ireland in 1900; and by the passing of the Weeds and Agricultural Seeds Act, which applied to Ireland only, at a later date (1909) the Irish Department was given a certain measure of control over the sale of seeds. Early in 1914 the Board of Agriculture for Scotland established a seed testing station, but no legislative control of seeds was attempted.

The main object of the Testing of Seeds Order was to protect the farmer against the danger of unknowingly purchasing and sowing seeds of low vitality and contaminated with noxious weed seeds. No attempt was made to force the farmer to use seed of a better quality than that which he was ready to buy; the aim was to compel the seller to disclose certain essential facts so that the purchaser could judge the value of the seed with a fair degree of accuracy.

The original Order was replaced on the 1st July, 1918, by the Testing of Seeds Order, 1918,† which widened the scope of the

* See this *Journal*, July, 1920, p. 367.

† See this *Journal*, July, 1918, p. 477.

first Order and made it applicable to all the principal kinds of cereals, grasses, clovers, roots and vegetable seeds. It requires that a declaration as to the percentage of germination and purity, presence of injurious weeds and other specified particulars, shall be made in writing to the purchaser at or before the time of sale or delivery of the seed.

This Order will remain in force during the forthcoming (1920-21) season and until the Act comes into operation on the 1st August next.

The main provisions of the new Act are as follows :—

1. The Minister of Agriculture is empowered to make regulations for carrying the Act into effect, scheduling the kinds of seeds to which the Act shall apply, laying down the manner in which samples are to be taken and dealt with, and any matter under the Act which is to be prescribed.

In dealing with an article which is subject to the changing conditions of season and method of handling, as in the case of seeds, any attempt to incorporate in the Act complete details of the control to be exercised would greatly hinder efficient administration. It is clearly desirable, therefore, that regulations should be issued from time to time to keep the requirements in touch with new conditions.

The Act provides that the Minister shall consult with " representatives of the interests concerned " before making regulations, and every regulation must be laid before each House of Parliament in the usual manner.

The first set of Regulations is now under consideration, and will be issued as soon as possible.

2. In the case of a sale of any seeds to which the Act applies and of any seed potatoes the seller must, at or before the time of sale or delivery, make a statement to the purchaser containing the prescribed particulars as to the variety, purity and germination in the case of seeds, and as to class, variety, size and dressing in the case of seed potatoes.

The particulars which it is proposed shall be given in the case of a sale of seed potatoes are similar to those required under the Seed Potatoes Order, 1918.* Seed potatoes are not covered by the Testing of Seeds Order. Other seeds, such as forest tree seeds and fibre flax seed, not included under the Testing of Seeds Order, will be scheduled under the Act.

* See this *Journal*, January, 1919, p. 1285.

3. Seeds and seed potatoes exposed for sale must have a statement containing the prescribed particulars "displayed conspicuously or in close proximity to the seeds or potatoes."
4. In the case of seeds, other than garden seeds, the test for the purpose of ascertaining the particulars to be declared by the seller must be carried out at an Official Seed Testing Station or at a private testing station which has been licensed by the Minister of Agriculture for this purpose
(Particulars as to the conditions under which a private station may be licensed will be issued at a later date)
- 5 The test must have been carried out not earlier than the 1st August immediately preceding the date of sale, except in the case of seeds sold or exposed for sale during the month of August or September, when the test must have been made not earlier than the 1st August in the previous year
- 6 The sale or sowing of seed containing above a prescribed percentage of injurious weed seeds is prohibited
- 7 Authorised Inspectors of the Ministry may enter any premises where seeds or seed potatoes are sold or stored and take samples for the purpose of having check tests carried out at the Official Seed Testing Station
- 8 A copy of the certificate of the result of the official check test will, in any proceedings against the owner of the seeds, be conclusive evidence of the facts therein stated
- 9 The Act does not apply to a sale of seeds under the following conditions —
 - (a) When sold to a person "purporting to purchase seeds with a view to cleaning them before they are sold or exposed for sale"
 - (b) When the purchaser gives the seller "an undertaking in writing that before selling or exposing the seeds for sale he will test or cause them to be tested."

This exemption is made to cover a sale of seeds through a "string" of merchants. It enables such seed to be passed from merchant to merchant without the necessity of a fresh test and fresh declaration being made in each case

- (c) When sold for delivery outside the United Kingdom, and

- (d) When sold for some purpose other than for planting or sowing.
10. A purchaser of any seeds who desires a test to be made for the purposes of civil proceedings must within 10 days of delivery take a sample and divide it into two portions; one part to be sent to the Official Seed Testing Station for testing, and the other part to be delivered or tendered to the seller.
 11. The Act also sets forth the penalties for failing to comply with the requirements laid down or for tampering with samples, but the prosecutions can be instituted only by the Minister.
 12. The Act provides that separate official seed testing stations may be established for England and Wales, Scotland and Ireland, respectively, but it is permitted that there should be a central Testing Station for the whole of the United Kingdom or for any two parts.
 13. The Act applies to Scotland and Ireland as well as to England and Wales, with the exception that the internal seed trade of Ireland will continue to be regulated under the Weeds and Agricultural Seeds (Ireland) Act, 1909.

MUCH has been said of the material benefit which farmers have derived from the rise in prices of all agricultural produce during and since the war period, and it cannot be denied that the agricultural interest has enjoyed a measure of comparative prosperity. It must, however, be remembered that there are two sides to every account, that while in the early days of the War the farmer's lot was very substantially eased, over the whole period the rise in the value of produce has been accompanied by a marked rise in the cost of materials such as fertilisers, feeding stuffs, seeds and agricultural implements, while at the same time the current rates of wages constantly increased and by the end of 1919 had more than doubled. These facts are lucidly set out in the Report on Prices and Supplies just issued by the Ministry.*

It is pointed out that a comparison of the movement in the money values of these different types of receipts and expendi-

* Agricultural Statistics, 1919, Vol. LIV., Part III. Prices and Supplies of Corn, Live Stock and other Agricultural Produce in England and Wales, and Summaries of Colonial and Foreign Agricultural Statistics. Cmd. 902, 1920. 6d. net. Obtainable from H.M. Stationery Office, Kingsway, London, W.C.2.

ture will not afford any true estimate of the extent to which the increased returns have been counterbalanced by the additional outlay on cost of production. A rough comparison, however, is of interest as showing how, in common with other industries, the increased returns from sales of produce have been accompanied by higher costs of production. In making such a comparison the average prices of the three years 1911—1913 have been taken as a fair basis for the pre-war period. On that basis a table of percentages has been drawn up to illustrate the changes in the war period as compared with the years 1911—1913 for each of the main products sold by farmers. In all cases the price of an average quality has been selected.

From these calculations it appears that the price for cattle, which in 1914 showed an increase of 6 per cent., rose in a gradually ascending scale to 132 per cent. in 1919. Milk rose from 3 to 200 per cent., sheep from 13 to 130, pigs from 6 to 176, wheat from 7 to 123, wool from 9 to 208, butter from 1 to 115, oats from 5 to 164, cheese from 4 to 169, beans and peas from 8 to 219, and vegetables from 8 to 157. Hay, which in 1914 showed a decrease of 23 per cent., increased in 1915 to + 6 per cent. and in 1919 to + 157. Barley, which decreased 4 per cent. in 1914, had risen in 1919 to + 167. In 1914 potatoes dropped 15 per cent., but immediately recovered, standing finally at 135 per cent. above the pre-war average. Poultry and eggs dropped 2 per cent. in 1914, but at the end of the period in question had risen to + 159 per cent. Fruit, which in the first two years of the War showed decreases of 16 and 5 per cent. respectively, rose in 1916 to + 38 and in 1919 to + 218. Hops in the first four years were respectively 54, 32, 19 and 9 per cent. below the 1911-13 average. In 1918 the increase had mounted to 93, and in 1919 to 113, per cent. above the pre-war average.

On a general view, measuring the change by an index number which takes into account not only the actual alterations in price but the relative importance of the various products in contributing to the farmers' exchequer, the percentage increase for the years 1914—1919 as compared with 1911—1913 shows the following progression per annum:—1, 27, 60, 101, 132, 158. This means that in 1914 there was practically no change, while in 1915 the increase amounted only to 27 per cent.; in each of the three following years prices rose very sharply by 30 to 40 per cent. of the pre-war average, and in the year of the Armistice they stood at 132 per cent. above

the pre-war level. In 1919 the upward movement continued, but the rate of increase was somewhat checked.

Turning to the other side of the account, the prices of farm requisites, we find the following changes. Milling offals in 1914 rose 3 per cent., and in 1919 stood at 130 per cent. above the level in 1911-13; barley meal and maize meal advanced from an increase of 5 to one of 191 per cent. Linseed and cotton seed cakes, which dropped by 5 per cent. in 1914, immediately thereafter recovered and finally stood at 186 per cent. over the pre-war average. Maize, with an initial rise of 2, finally touched 147 per cent. Brewers' grains, after a drop of 9 in 1914, reached in 1919 a price 173 per cent. above that of 1911-13. Sulphate of ammonia, having dropped 13 and 5 in the first two years, rose to + 19 per cent. in 1916 and in 1919 stood at + 18 per cent. Nitrate of soda, after a fall of 4 per cent. in the first year, went as high as + 156 per cent. in 1918 and in 1919 was marked at 114 per cent. above the 1911-13 average. Basic slag, showing no change in 1914, rose at length to 110, and superphosphate advanced from 3 to 165 per cent. over pre-war rates. It is shown that whereas the average cost of the principal artificial manures, excluding lime, was in 1911-12 £3 19s. per ton, in 1918-19 it rose to £6 18s. 9d., and in 1919-20 to £8 14s. 6d. per ton—an increase of 121 per cent. as compared with 1911-12. Seeds and machinery also show a very considerable increase in price, although it is difficult to estimate with any accuracy as the quantities purchased are not known.

The farmer's problem was complicated by the marked advance in wages, and it is calculated that the average increase by the end of 1919 was to be measured by a figure between 130 and 140 per cent. as compared with pre-war rates. To sum up, the general rise in the price of farm produce sold was about 158 per cent.; feeding stuffs increased by 184, fertilisers by 121, seeds by 140, and machinery and implements probably by 94 per cent., while the cash wages advanced to the figure already stated—130 to 140 per cent. above pre-war rates. It is manifest that the better prices which the farmer obtains are to a very large extent set off by the increased cost of what he has to buy.

THE improvement of moorland pasture formed the main subject of a lecture given by Professor D. A. Gilchrist, of Armstrong College, Newcastle-on-Tyne, to farmers at Skipton on 6th September, under the auspices of the Ministry's grassland campaign.

The Improvement of Moorland Pasture.

The mountain and heath land in England and Wales used for grazing extends, it was pointed out, to over four million acres, and while a large proportion of this area is not capable of improvement (especially such as is bare rock or poor peat), considerable patches of better moorland pasture are to be found which are better eaten off by grazing stock, and which usually contain small clovers and other leguminous plants in their herbage. Much of our present moorland was under cultivation many years ago, and such areas, together with the better areas of virgin moorland, are those on which improvement is likely to be possible.

Examples of Improvement by the Use of Basic Slag.—Professor Gilchrist took as examples two moorland farms in the Hexham district. The first farm is about 750 feet above sea level, is 360 acres in area, and consists half of virgin moor and half of moor formerly under cultivation. Excellent meadow hay is now grown on this farm as the result of suitable dressings of basic slag and dung; and marked improvement has been obtained on virgin moor within two years by the application of 10 cwt. per acre of high grade basic slag. The difference between slagged and unslagged moor is very striking.

The second moorland farm is at an altitude of nearly 1,000 feet, and is 1,130 acres in area. Sandstones of the Millstone Grit are the main underlying rocks, and the lower land of the farm lies chiefly on Boulder Clay, with occasional smaller areas of Glacial Sands. Much of the land has moorish peat on the first few inches of the surface. On this farm, where clover and other leguminous plants exist, basic slag has largely developed such herbage, and consequently the grass herbage as well. One enclosed area has received two dressings of basic slag in the past ten years, and has now excellent grass and clover herbage, while, immediately beyond the wall of the enclosure, the moor is of a poor character, producing little but heather and similar plants. On the unenclosed moorland basic slag has improved quite large areas, which are well distributed in order to encourage the grazing stock to keep

moving over the moor; special attention is given to this practice, as it results in the whole moor being better grazed and consequently improved.

The following plan of management is to be adopted on the latter farm:—

(1) About 50 acres mown annually for hay will receive, if possible, a dressing of 10 tons of dung per acre every fourth year, with about 7 cwt. per acre of high grade basic slag (or the equivalent quantity of lower grade) every fourth year. Such combination of slag and dung for meadow land has been most successful at Cockle Park, and it is certain to be so on moorland farms. The quantity of hay should be increased, the nutritive value improved, and the autumn and winter grazing should be of a much more valuable character.

(2) About 7 cwt. per acre of high grade basic slag (or the equivalent of low grade) will be applied every fourth year on all the enclosed pasture land on this farm (except the poorer and more mossy pasture).

Grazing with both Cattle and Sheep.—Sheep reject herbage of a benty character and graze only the fine bottom herbage, which they bite very closely, so that pasture grazed with sheep alone becomes rough and benty. Cattle graze more evenly and not so closely, and their heavier treading is also a great advantage. At Cockle Park pastures treated similarly in other respects produced live weight gains of 200 lb. per acre per annum when grazed with a mixed stock of cattle and sheep, and only about 100 lb. when grazed with sheep alone.

Grazing by cattle is further beneficial in that it does much to prevent the accumulation of dead and matted organic matter on the surface. Such matter makes improvement especially difficult on much moorland, because basic slag in such cases has no chance to penetrate to the soil underneath.

It is therefore of great importance that more cattle should be kept on moorland farms.

High Grade Basic Slag and Mineral Phosphates for Moorland.—The difficulty of access to moorland increases the cost of conveying manures for application, so that the highest grade manures obtainable should be used. Professor Gilchrist made a strong plea for the reservation of a certain proportion of our highest grades of basic slag for moorland improvement. He also referred to the phosphatic deposits of the Island of Nauru, surrendered by Germany, which are said to be capable of pro-

viding 80 to 100 million tons of high grade phosphate rock in all, and an annual supply of 400,000 tons. Ground phosphates have given most satisfactory results in the improvement of pasture, and should trials of Nauru phosphate prove a success a phosphatic manure will be available at least 50 per cent. richer in phosphates than our highest grade basic slag, and of the greatest value for the improvement of moorland.

THE following notes on the winter feeding of poultry have been contributed by the Harper Adams Agricultural College, Newport, Salop:—

**Winter Feeding
of Poultry.**

The present scarcity of foodstuffs makes proper and adequate feeding difficult. Good feeding corn is practically non-existent, and the mixtures available are not only high in price but very inferior in quality, and if it is at all possible are better avoided. There is a certain quantity of maize available. Crushed oats can also be procured, but many of the samples contain an undue percentage of Black Tartarian. Good sharps are difficult to obtain at an economical price, although where procurable they represent better value for money than do the poorer qualities.

Breeding Stock.—Such birds should now be fed with a view to getting them safely through the moult and in a hard condition for the breeding pens in two months' time. Where the moult has not started they should be put on a low non-forcing diet, so that they may be thrown into a moult as soon as possible. All soft food should be discontinued and corn only fed until the moult starts. Afterwards the birds should be fed liberally in order to build up their strength rapidly in readiness for the possible bad weather that may soon set in.

Young Stock.—Liberal feeding will be well repaid. Scalded fish meal and bran, dried off with crushed oats and sharps with enough milk (whole or skimmed) to make the mass crumply moist will be the most economical soft feed. Wheat, clipped oats and kibbled maize in the proportion of 2 : 2 : 1 makes an expensive but satisfactory corn feed. Smutted wheat should be avoided, as it will cause the birds to scour. Vegetables, either cooked or raw, should be fed with the soft food. Not only are they essential to the health of the birds, but they will bulk the food very cheaply and reduce the cost per head. A dusting of charcoal in the soft food is decidedly beneficial.

Birds in Laying Houses.—Corn scattered in litter the first

thing in the morning and last thing at night gives excellent results. The quantity should be $\frac{3}{4}$ oz. per bird in the morning and $1\frac{1}{4}$ oz. per bird at night. A suitable mixture would be wheat, oats and kibbled maize in the proportion of 2 : 2 : 1. Soft feed should be given at mid-day, to include plenty of vegetables, cooked or raw; bran 1 part; fish meal 2 parts; crushed oats 4 parts; and sharps 8 parts. Soft food should be mixed the previous evening. Grit and shell should be continuously before all birds; the average consumption by a bird in full lay is $8\frac{1}{2}$ lb. per annum.

Surplus Cockerels.—The aim with surplus cockerels should be to get the birds as heavy as possible, although unless a "killing" trade exists it is questionable whether they will repay much trouble and expense. As soon as they reach a marketable size they should be penned and fed for three weeks with a view to putting on flesh. Equal quantities of crushed oats, barley meal and cooked potatoes may be fed, mixed with sour skimmed milk. This represents a cheap mixture to finish off the birds where no special fattening facilities exist.

A small quantity of greaves, up to $\frac{1}{2}$ oz. per bird, may be gradually introduced into the mixture.

The cockerels should be starved for 24 hours after penning, and sold at the end of three weeks, as after that time the birds rapidly lose condition.

HATCHING operations have at this time of the year for the most part ceased, and the young stock reached a stage requiring less frequent attention. The

Winter Egg Production.

detection of the sexes among the March and April hatched chickens that will provide the pullets for the production of eggs during the winter months is by now within the powers of any novice, and the numbers for which provision has to be made can be easily ascertained. A very important point to remember is that no more birds than can be properly accommodated should be retained. It is far more economical to sell off some of the pullets than to overcrowd the houses or pens. Surplus pullets command a ready sale at good prices, and if reared in adequate space will improve greatly in quality.

Except for small flocks enjoying a good range and a sheltered position, the birds should have a covered shelter in addition to the roost house. The extra expense entailed is well repaid, pro-

vided management in other directions is satisfactory. Houses and shelters could be repaired, cleansed and disinfected before the birds are placed in their winter quarters, and if still on range or on the chicken-rearing ground, they should be settled in these quarters by the end of September; indeed, the early part of that month is generally the most suitable time. The fowls become accustomed to the new conditions, and run less risk of being upset by a change made after they have begun to lay.

The birds should always be gently treated. Careful handling, quiet movement in tending, and avoidance of any usage that will frighten them should always be the aim of the attendant.

During bad weather, the proper exercise and occupation of birds under shelter is promoted by throwing grain among the dry litter on the floor of the shed. If no shelter be available and the birds have the benefit of a wider range, rough litter should be placed on one spot in the open with the same object in view, and grain thrown into it to encourage scratching. This is to be recommended, inasmuch as birds, even upon wide range during the winter months, frequently find little inducement in the shape of insect life or any natural food to tempt them far from their house, and, failing occupation, they return to the roost and mope on the perches. In this connection, it is necessary to call attention to a frequent mistake of the novice who, in his eagerness to keep the birds busy, over-does the exercise by hiding too effectively the grain or burying it in material too heavy to be turned over easily.

The question of food is particularly important. There is little risk of over-feeding where the diet is properly chosen. If the bird is so placed that no facilities exist for obtaining supplies from natural sources, greater skill is called for, but in any case Nature's supplies in the winter months are too scanty to provide material for egg production. This must be made good by extra attention to feeding.

Poultry keepers in the past looked upon grain and the products of grain as of the first, and sometimes of the only, importance. This question is now better understood, and the use of animal matter, meat or fish offals, blood, or meals prepared from these, is now known to be a necessity for winter egg production where insect life is absent. Vegetable food is of equal importance, and frequently part of the money which is spent upon grain would be far better invested in green food. Any kind of vegetable is valuable; turnips, swedes or occasional mangolds will answer in

the absence of green stuff. Grain, meal, animal and vegetable food must all be included in the diet of the pullet that is expected to produce winter eggs, but to secure production upon an economic basis, a due proportion of each, and the use of material which is not fit for human consumption, is required. House scraps afford most valuable food.

It is generally better to provide three sufficient meals a day than to surfeit the birds at any one meal. In the natural state fowls are intermittent feeders and will keep in a more healthy condition if fed in small quantities at short intervals. Where constant attention cannot be given, "dry mash" is particularly valuable. Airy, light quarters are a great factor in developing the production of winter eggs, while cleanliness of the houses and of the birds themselves is an essential condition.

Poultry-keepers should be warned not to "coddle" their birds. No harm will be taken by poultry let out in the open in any weather so long as they have broken fast before release, and have dry and sheltered quarters to which they can return. Birds shut up on bad days and only liberated under congenial conditions will fret, with consequent loss to their productive powers. Allowed out in any weather, poultry make full use of the shelter provided if it is sufficiently light and comfortable to attract them.

THIS year, owing to the late season, labour troubles, the laying crops and consequent difficulty in harvesting, a larger amount

**Poultry on
Stubbles.**

of grain than usual has been left on the ground where the corn is cut. This will not be lost if poultry be placed on the fields after the corn has been carted. On many farms carrying a head of 200 to 300 fowls and a proper equipment of portable houses, the fowls are on the stubbles for six or eight weeks after harvest. It is customary to move them from one field to another. During their stay on the stubble no food is supplied, and the fresh ground and ample natural nourishment stimulate layers to renewed activity. Under such treatment the young stock make rapid progress, and the cost of a house may very speedily be repaid. More farmers might well take advantage of opportunities afforded in this direction. In every district some arrangement for placing fowls on the stubble should be possible between the farmer and neighbouring poultry keepers.

It is unfortunate that in districts where the depredations of foxes render the stubbling of poultry an impossibility, only

large flocks of turkeys or geese can be utilised. In such cases an attendant can be put in charge during the day and the flock driven home each evening.

Care should be taken not to overcrowd fowls in the houses, as the health of the birds suffers considerably from confinement all night long in the stuffy atmosphere, with a consequent loss in egg production.

The purchase of houses at the present high price is not always advisable, but in many instances a little time and ingenuity will provide what is necessary at very moderate expense. Rough erections in the corner of a field will afford all the shelter that is required by a fowl at this time of the year. To the right angle formed by two banks of earth a third bank of turves can be added, and a few sheets of iron, an old cart cloth, or similar covering used as a roof. To make the shelter proof against foxes or dogs, six-foot netting can be used to surround the construction. If repaired annually, such a shelter could be utilised for a number of years.

A very useful temporary fowl-shelter can be erected by driving a few stout posts into the ground and nailing to these a light frame, over which netting should be stretched. Bracken, straw or any other suitable material should be spread over the netting and a second layer of netting placed over the top. After use the straw can be removed and utilised in the yard, but the frame may be left standing ready for another year. Simple arrangements of this description should be so placed that the birds have access to several fields. In this way any special field not available for the poultry to run could be shut off with a roll or two of 3-ft. netting along the hedges. Less difficulty in stubbling fowls would then be experienced.

Quite apart from the use to which grain, otherwise lost, would be put, much is to be said for the benefit the land will derive from occupation by poultry. The manure is of great value, and the birds are very useful in keeping down insect pests, particularly the wireworm.

It is often objected that if the birds are in fields distant from the dwelling house attendance is difficult. There is also the risk from thieves, both human and four-footed, but when such risk is not serious the disadvantages are quite outweighed by the benefits received. In some instances it may not be necessary to close the trap doors at night. Not only is trouble thereby saved but it is an advantage to the birds to be out at daylight, and in some cases if necessary they may even be left

unattended for a day or two provided with sufficient water. Eggs would then be collected only every other day, but a visit is to be preferred.

Not infrequently it may be possible, by arranging with an employee who passes to and from his work, to close the houses at night and liberate the birds in the morning, or a schoolboy may be enlisted for this duty. If the flock is large and the weather hot, to obtain an adequate supply of water is sometimes a problem. Where the houses are portable a good method is to have a water cart and to move houses and cart together from field to field as the grain is cleared up.

Cleaning must not be neglected, and careful watch should be kept to ascertain that the birds are gleaning sufficient food. Their "crops" should be felt periodically at night. In pre-war days it was not uncommon for a poultry keeper to pay a farmer from 3d. to 6d. per head for the privilege of placing his birds on the stubble, or, alternatively, in return for the use of the stubble, the farmer might be granted permission to use the poultry keeper's meadow for grazing sheep during autumn and winter.

* * * * *

FROM the Rates Advisory Committee's Part M Report of 30th July, 1920, containing the revised railway rates, tolls and charges, the following information has been compiled as a guide to agriculturists, and it is hoped that it will lessen the difficulties that must inevitably follow a change in the system of charges which custom has made familiar. Broadly speaking, all the modifications and exceptions in favour of agriculture, incorporated in the revision which became operative on 15th January last, have been withdrawn as from 1st September, and agricultural material will be charged on a basis similar to that for other commercial commodities. There is, however, one notable exception to this general withdrawal of previous concessions, namely, for manure in bulk, packed manure, basic slag and lime conveyed by merchandise train in minimum loads of two tons for use as agricultural manure in the United Kingdom. For this traffic, the rates charged will be those in operation on the 14th January, 1920, with an addition of 50 per cent.

The following additions have been made in the rates for various commodities in which the farmer is interested:—

150 per cent. increase on parts of machines and other small parcels weighing 3 cwt. and under, when conveyed

by merchandise train. If conveyed by passenger train, the increase is 75 per cent.

The under-mentioned are subject to an increase of 100 per cent. plus a flat rate addition per truck, part truck or ton, with a maximum addition of 4s. per ton in the case of class A traffic. Details will be given on application to the railway authorities:—

Live stock, at truck rates or at head rates; grain and cake for cattle feeding; vegetables, including potatoes; agricultural machinery, other than parts already specified; returned empties, whether by passenger or goods train; basic slag; coprolites and rock phosphate—ground or unground; and pyrites, burnt or unburnt.

An increase of 75 per cent. is made in the case of:—

Milk and perishable merchandise, conveyed by passenger train.

Fifty per cent. increase with flat rate additions is added in the case of:—

Chalk, kelp, lime, limestone ground, manure, compost of manure, fish, gypsum, mucilage, sud cake, sugar scum, animal offals, fish offals, potash manures, salt, sea-sand, sodium sulphate, soot, spent hops, and certain refuse intended for manure.

At the same time, it is important to note that what is described as packed manure, together with basic slag and lime, conveyed by merchandise train for use as agricultural manure in the United Kingdom, enjoys a special concession. For this traffic the rates will be 50 per cent. above those in operation on 14th January, 1920, plus the flat rates, and are irrespective of distance. One important feature in this connection must not be overlooked. In order to take advantage of the concession, the fertilisers must be dispatched in loads of not less than 2 tons, and it is hoped that, where possible, full loads of 4 to 5 tons will be consigned. These "packed" manures are as follows:—

Nitrate and sulphate of ammonia, artificial manure, basic slag, blood or bones, calcium cyanamide, carbonate of lime, coconut refuse, flue-dust from blast furnaces and cement works; guano, kainit, leather shavings, nitrate and superphosphate of lime, nitrate of soda, sulphate of potash, shoddy dust, carbonised or not carbonised; shoddy manure, and willowers' waste refuse.

As the modified percentage additions apply only to fertilisers intended for agricultural purposes in the United Kingdom,

such traffic must be distinctly consigned "For agricultural use in the United Kingdom."

The information given here is not intended to act as a substitute for inquiries at the railway station, but as an aid to such inquiries.

* * * * *

THE proper storage of vegetables adds greatly to the value of an allotment or cottage garden. Cultivators should plant varieties suitable for winter use and choose for late summer sowing such crops as beet, carrot and turnip, which will weather the winter in the ground. Vegetables which cannot be left should be harvested in good time and laid up in the proper way and during the right weather. Some should be stored dry, while others must be kept under such conditions as will check growth and at the same time prevent loss of moisture.

It is of the greatest importance to observe favourable conditions for the storage of potatoes, which are liable to wastage from four principal causes:—

1. Sweating and heating, due to insufficient ventilation:
2. Rotting, due to wet:
3. Injury from frost, due to insufficient protection:
4. Decay, caused by disease existing in the tubers at the time of storage.

Potatoes also deteriorate through sprouting and are liable to damage by rats and mice.

Where large quantities of potatoes have to be stored, a "clamp" or "grave" must be made, but for small quantities a cool, dry, frost-proof shed will be sufficient. In the shed the potatoes are spread in layers on the floor, and may be placed on a bed of straw or bracken. The layers of potatoes must not be more than $2\frac{1}{2}$ feet deep, lest heating and sprouting should ensue. After storage, an inspection should be made and any diseased specimens removed. The buildings should be rat-and-mouse-proof. Due care should be taken to exclude light by covering the potatoes with straw, litter or sacking, and the store-room should be ventilated periodically. In the absence of a suitable shed, quantities of less than one ton of potatoes may be stored in a "clamp." For small quantities the clamps should be in the shape of a cone built as high as possible, and well covered with as straight straw as can be obtained. Moderate amounts for household use may be stored in thick bags and kept in the larder. A sprinkling of quick-

lime and flowers of sulphur will help to keep down disease, for which it is well to be on the watch during late autumn. A good protection from frost is formed by throwing old sacking over the bags. In very severe weather, extra covering should be put on at night. In many houses there is a space beneath the roof which makes a good potato store in the absence of more convenient accommodation. If this is used, potatoes should be kept in boxes placed upon the rafters and protected with old sacking and several layers of crumpled newspaper. Cellars will also answer as potato stores, provided they are thoroughly dry and well ventilated. If the floor is damp the potatoes should be placed in boxes raised on bricks.

To store large quantities of potatoes out of doors, the best medium is the "clamp," which should be in the driest part of the ground. A strip, 3 ft. 6 in wide and long enough to take the potatoes, is marked out. After grading, the potatoes are piled in a heap, the two ends of which are triangular and upright. The sides and ends are covered with a layer of long wheat-straw, reaching almost to the top of the potatoes, and at the bottom well pressed down to the ground, as it is along the edge of the clamp that frost most easily enters. The ridge may be thatched over with a cover of long straw (wheat or barley, not oat) so that the ends overlap the straw covering at the sides. Rain will thus run off, and not into the clamp. At the approach of winter the heap is finished, except along the middle of the ridge, by covering it with a thick coat of soil dug out along the sides. This digging forms a drainage trench, from which an outlet should be cut to allow water to escape. Six inches of earth will give protection against moderate frosts, but it is advisable to put an extra three inches on the colder side. A thick layer of short litter should be placed upon the ridge. Unless decay occurs, the clamp may be left undisturbed until February.

Clamps of similar construction may be used for the storage of spring-sown beet, carrots, Jerusalem artichokes, parsnips, salsify and celery. Turnips are best left in the ground, but may be dug up at the approach of severe weather and "clamped" or buried in sand or ashes in a cool shed. Leeks, kohl rabi, Brussels sprouts, savoys, kale and spinach-beet should be left in the ground until required. Autumn-sown onions may be tied in ropes and slung in a cool, ventilated shed or laid two or three deep on battened shelves in an airy room. Vegetable marrows, if cut just before they are ripe and hung

in a cool, dry place, will keep for months. Herbs for flavouring should be dried, and the leaves rubbed off the wiry stalks and kept in well-stoppered bottles.

* * * * *

THE county of Essex is setting a good example in the promotion of village handicrafts. At Coggeshall a tambour-lace

**The Development
of Rural
Industries.**

industry has been established, and at Braxted the villagers have taken up doll-making. Classes of instruction and the actual practice of rural industries are carried on at Ingatestone, Dedham, Halstead, Kelvedon, Finchingfield and other centres. For the last ten years the Essex Handicrafts Association has furthered the work of instruction and organisation, and it is anxious to revive the ancient handicraft of rush-plaiting, still understood by some old residents who have preserved their skill, although the industry itself has fallen almost into disuse. It is proposed to encourage the older people to instruct the younger in the methods of what may be regarded as virtually a lost art.

Throughout the country the Home Arts and Industries Association is doing excellent work, and to this body many County Associations are affiliated. Instruction is given in modelling, casting, joinery, wood and stone carving, turning, carpentry, inlaying, brass and copper work, bent-iron work, hand-spinning and weaving, toy-making, embroidery, rug-making, pottery, leather work (embossed and cut), and basket-making. Many branches of the National Federation of Women's Institutes have also started village industries, and are finding a ready market for their wares. County Agricultural Committees, it is suggested, will be able to give valuable help in co-ordinating and furthering rural enterprise in handicrafts.

General advice and information as to the organising and conduct of societies is provided by the Rural Industries Branch of the Ministry.

* * * * *

DURING the coming winter the prices of jam and of sugar are certain to rule high. It is, therefore, not inopportune to

**Jelly from Cider
Apples.**

recall particulars of a method by which a supply of apple jelly can be made cheaply. A few years ago, when the possibility of converting cider apples into jam or jelly was investigated in the laboratories of the National Fruit and Cider Institute at Long

Ashton, Somerset, it was found possible to produce a very palatable jelly without the addition of sugar or glucose, although, needless to say, better results are obtained if at least half the usual quantity of sugar is used. By following this method, a supply of home-made jelly can be simply and inexpensively made in districts where cider-apple juice is obtainable. The cider apples especially suitable are the sweet and bitter-sweet varieties. Sharp or sour varieties will, if used by themselves, give a jelly of too acid a flavour. They can, however, be used, if mixed in small quantities with the sweet and bitter sweets. The method of making the jelly, the kinds of apples required, and other uses of concentrated apple juice, are explained in a leaflet which can be obtained on application to the Agricultural and Horticultural Research Station, Long Ashton, Bristol, to which address any inquiries should be directed. It may be added that, although cider apples are not generally used for domestic cookery, they may be made quite suitable for this purpose by the addition of tartaric acid. Information on this point also can be obtained from the same quarter. This year the cider apple crop may not yield a surplus, but in cases where wastage is likely to occur, it can be obviated by using the fruit as indicated here.

SUCCESSFUL experiments in the destruction of charlock have been carried out this year on two cornfields, part of the

**Destruction of
Charlock;**

**Experiments in
Northamptonshire.**

Northamptonshire County Council farm at Moulton, under the direction of Mr. W. A. Stewart, the Agricultural Organiser.

Both fields were sprayed with a four per cent solution of copper sulphate—the first field on 18th May, before the flowers had formed, and the second field at the beginning of June, when numerous plants were in flower. The weather conditions during the spraying of the first field were for the most part dull and wet, while parts of the second field were sprayed under both wet and dry conditions.

The spraying was successful whether the charlock had flowered or not, and whether the operation was carried out in wet or dry weather. Spraying when the charlock was in flower was more effective than earlier spraying, and the drier the condition of the crop the more drastic was the effect of the copper sulphate on the

charlock. The corn itself was slightly more damaged in the later spraying and also under the drier conditions. In no case, however, was the corn crop permanently injured; such damage as occurred was only temporary.

It was further found that the more water used per acre (even without increasing the quantity of copper sulphate) the better the distribution and the more effective the results. On the first field, not only was the charlock practically eradicated as a result of spraying, but other weeds, notably thistles and coltsfoot, were affected, an exception being the corn sow thistle, which persisted. Hand pulling was tested on the second field, and, while successful, was found to be considerably more expensive than spraying with copper sulphate.

* * * * *

Norfolk.—No outbreak of the disease has occurred in the Emneth district since that referred to in last month's issue, p. 528, at Pentney, on the 18th August.

**Foot-and-Mouth
Disease.**

In view of the favourable position, successive reductions in the extent of the area under restrictions were made as from the 3rd and 11th September, and eventually all remaining general Foot-and-Mouth Disease restrictions on movement, imposed by the Orders of the Ministry, in Norfolk were withdrawn as from the 21st September.

Sussex (East).—Foot-and-Mouth Disease was confirmed on premises near Uckfield on the 23rd August last, and it was accordingly necessary to impose restrictions on the movement of animals over the usual 15 miles area which embraced parts of Sussex, Kent and Surrey. There was one local extension of this outbreak on the 27th August. In view of the continued satisfactory position in the district since the latter date, it has been possible to withdraw all restrictions, except in respect of a small area of about 5 miles diameter surrounding the actual outbreaks.

Kent.—It has unfortunately again been necessary to impose restrictions over a wide area in Kent on account of the confirmation of Foot-and-Mouth Disease in that county, an outbreak having been confirmed on the 11th September on premises at Boughton, near Faversham. Fortunately, the premises were well isolated, and it is hoped that there will be no further spread of the disease in the district.

THE HISTORY OF A GRAIN OF WHEAT FROM THE SEED BED TO THE BREAKFAST TABLE.

SIR A. DANIEL HALL, K.C.B., F.R.S.,

*Chief Scientific Adviser and Director-General of Intelligence
Department, Ministry of Agriculture.*

ON 24th August Sir Daniel Hall gave the concluding evening discourse at the Cardiff meeting of the British Association, and chose as his subject "The History of a Grain of Wheat from the Seed Bed to the Breakfast Table." He began by pointing out that there exist in the history of mankind no processes older, more essential or more universal than the growing, grinding and baking of wheat and its kindred food grains. It might seem, therefore, rather unnecessary, before a gathering for the advancement of science, to talk about a business which had been brought to something like perfection long before anything that could be called science had come into being. Countless years have elapsed since primitive man took the momentous step of sowing a little of the wild grain he had hitherto been content to gather, in the hope of saving himself some trouble in collecting the next year's crop. Millions of men have spent their lives in growing wheat, and, since the very life of the community has often depended upon a good wheat crop, all sorts of rewards have attended on its improvement. What possibly can there still be to learn about it? Yet at every stage in the passage of the grain of wheat from its seed bed to the breakfast table we find that we do not know all that we need to know in order to get on with the essential business of making two grains grow where one grew before.

Population overtaking Wheat Production.—The object of the lecture was to show that even in this fundamental industry science keeps coming in at every turn, and that research calling for the best of man's imagination, skill and determination is required if the world's progress is to continue. All biologists would agree that the development of man demands an abundant food supply, just as the gardener knows he cannot attain to fine flowers except upon a fat soil. But the population of the world is rapidly growing up to, if it has not for the moment exceeded, its available supply, and only by research and by the wide utilisation of the fruits of that research can we obtain the greater supply of food that the world needs. The most potent remedy for the

present discontents would be more wheat, and as the limits of potential wheat land have almost been reached the present problem is that of getting more wheat out of the land we possess.

Life of the Wheat Grain.—On examination the grain of wheat will be found to consist of a tiny embryo, the part which is alive, together with a much larger store of food called the endosperm, the function of which is to nourish the embryo until it can push a green leaf above the ground and begin to feed upon the air and the soil. Our food supply is the store which the plant accumulates to feed the embryo, for flour is nothing but the endosperm of the wheat berry in a powdered condition. As long as it is dry the embryo cannot draw upon the store in the endosperm. Since the embryo has to consume something in order to maintain its life it soon dies from exhaustion of its own substance, and with it the whole grain dies even though the endosperm is still unaltered. When stored some grains of wheat will die within a year, many more in two years, and very few will survive for such a period as 10 years. The idea that grains of wheat stored up with mummies in ancient tombs can be made to give a crop is a pure error.

Many experiments have been made in recent years in order to ascertain whether the seed cannot be excited by electricity or by steeping it in some nutrient fluid before it is sown, by which means it can be made to grow better and give a bigger crop. The results of these experiments, however, are very dubious. After all, the seed is only a means of starting the embryo into business. How well it will grow after the first week or two and what yield it will give depends upon the later development, which is determined by the soil, the available manure, the weather and other factors, quite apart from the seed. None of the exciting processes can add anything to the stock of energy contained in the seed and can therefore have little to say to its ultimate development, provided the seed is initially capable of starting at all.

Influence of Rate of Sowing Wheat on the Yield.—In the ordinary way in this country wheat is sown at the rate of about 2½ bushels to the acre, and the average yield is about 32 bushels, or a thirteenfold yield. Now an isolated wheat plant is capable of giving a hundredfold or even a thousandfold yield, and the question is often raised of whether we are not sowing an unnecessary amount of seed. If we examine the plants along the drill line in a wheat field we find that though there may be gaps there are a great number of spots where the seeds have come up too

thickly and are combating with one another to the detriment of the crop. Experiments are in hand for the improvement of the spacing of the wheat seed, and it is claimed that with a suitable machine a perfectly effective seeding can be attained with as little as a bushel to the acre. Even if we could reduce the amount of seed used by one bushel an acre the country would gain 3 per cent. on its output of wheat, worth well over £1,000,000 a year at the present time.

Varieties of Wheat.—Before sowing wheat it is necessary to settle what variety to grow, for hundreds of different sorts of wheat exist—some early, some late, some tall, some short in the straw, some close packed and others open in the ear. We know little about the original wild wheat or wheats, but nowadays varieties of the most diverse kinds in colour, shape, and size exist. In the ordinary way each of these sorts breeds perfectly true, because the flower of the wheat is self-fertilised. Here and there by a rare accident fertilisation does take place in the open field, and it is through these accidents that the multitude of varieties have come into being. As long as the wheat is normally self-fertilised selection can do little to improve it. If, for example, a farmer picks out from year to year the longest ears in the field or the plumpest berries in the sack and sows them he will not find that these characters persist in the next crop, which goes back to the old standard. Selection of this kind has been tried for fifty years in succession, and the wheat at the end could not be distinguished from samples of the first crop that had been preserved. In order to get new varieties there must be deliberate cross-breeding and selection among the progeny. This process was a very haphazard one until latterly, when Mendel showed the mechanism by which selection can be applied so as to pick out among the hybrids the desirable ones that will continue to breed true.

Working on Mendel's principle it is possible to combine in a new variety desirable points possessed by either of the parents; to combine, for example, a stiff straw in one parent with strong milling qualities possessed by the other parent. Professor Biffen, of Cambridge, has been working for many years on these lines. His first success was "Little Joss," a wheat with a wonderful cropping power on certain soils, because an extra power of resisting rust attacks had been introduced into it through its parentage. Afterwards Professor Biffen turned to the problem of combining the cropping powers of certain English wheats with the high milling quality of the wheats, for example, grown in Manitoba.

One of these wheats, "Yeoman," has given phenomenal crops on soils to which it is suited, and, while it is probably the heaviest cropping wheat generally grown, it yields flour almost up to the quality of the best Canadian. On many Eastern county farms the introduction of Professor Biffen's varieties has raised the average yield of wheat by at least 10 per cent. Many years of patient work are required before all parts of the country are provided with ideal varieties of wheat as regards their cropping power, the strength of their straw, their resistance to disease and the milling quality of their grain.

Wheat v. Weeds.—In spite of its vigour wheat when left to itself cannot stand up against the competition of weeds. At Rothamsted a wheat crop was once left unharvested to sow itself without further cultivation, and by three years the wheat had entirely disappeared in the grassy wilderness that had sprung up. But though wheat is thus dependent upon cultivation, no other plant possesses an equal capacity for producing a crop upon all sorts of soils, even upon the poorest. At Rothamsted upon one of the plots wheat has now been grown for 77 successive years without any manure, and it still yields about 12 bushels to the acre, which is approximately the average crop of all the wheat lands of the world. The adaptability of wheat is seen from the way it has become *the* crop for breaking in the wilderness. In the newer countries—South and North America or Australia—the settler upon virgin land always begins by taking a succession of wheat crops before he resorts to mixed farming. In the Argentine, for example, the wheat belt has crept across the country with each wave of settlement, being followed in very many cases by a sowing of lucerne (alfalfa) upon which the cattle are raised.

Manuring of Wheat and the Problem of Lodging.—By investigation, particularly by the Rothamsted experiments, it has long since been settled what manures are required for wheat. The chief trouble in this country is to get the wheat to stand up upon the richly manured land. In fact the main limitation at present upon the yield of wheat on the good soils is the liability of big crops to lodge. This problem of lodging affords a varied field of investigation, because so many factors have to be considered. On the one side we may attack it by breeding varieties with stiffer and shorter straw; on the other hand time of sowing, width of rows, and spacing of the seed requires consideration, together with methods of cultivation. More knowledge is required of the manures which will correct the tendency to go down, and there

is probably also an actual disease factor involved. On all these points experimental work is in progress.

Transfer of Food Material from the Plant to the Grain.—

Experiments have shown that the wheat plant practically completes its growth, as far as gathering material from the air and from the soil is concerned, a month or five weeks before it is harvested. In this latter period the valuable material already accumulated by the plant is being moved from the stem and the leaves to the seed. This migration is very incomplete. The straw still retains half or more than half of the valuable material manufactured by the plant. Considering that the total material manufactured by the plant represents the limit of its capacity as a living organism and is determined by conditions outside our control, such as the soil and water supply, one line of improvement must clearly be to increase the migration into the seed and to ensure that the greatest proportion of the plant ends in the useful grain and not in the comparatively useless straw. Improvement in this direction is especially urgent in the drier countries where there is an absolute limitation of the amount of growth by the insufficient water supply.

Milling of Wheat.—Turning now to the flour, the object of the modern miller is not to grind wheat into a meal and then sift out the flour, but to crack the berry with the least amount of breaking up of the husk or bran, thus letting the endosperm fall out in a clean condition. The best white flour is practically pure endosperm in a powdered state. It is the most digestible part of the grain, and weight for weight yields the most food. Before the War only about 68 per cent. of the weight of the grain was recovered as white flour; the remainder passed into the various offals, which were chiefly used for pig feeding. Under the stress of war it was necessary also to bring into use the less digestible portions of the grain, and the extraction of flour from wheat was raised from 68 per cent. to over 90 per cent. Careful digestion experiments were made, and they showed that this higher extraction and addition of the less digestible portions of the wheat grain did increase the amount of real food by an amount which was equivalent to an extra two months' supply of wheat. The outer portions of the wheat berry that are rejected from white flour do also contain certain specially valuable food adjuncts, but, as many people learnt, are not suited to all constitutions.

Bread Making.—Flour made from the majority of English wheats without any admixture produces small dense loaves,

whereas certain Canadian and other wheats grown in similar climates give rise to big spongy loaves of the kind which the public prefer. In consequence, even the country miller is compelled to use a considerable admixture of strong wheats of overseas origin. In the course of the investigations that were set on foot by the Home Grown Wheat Committee, some 20 years ago now, one wheat was found which retained in the English climate this special property of giving a strong flour. This wheat grown in England is too poor a cropper to be profitable, but it has supplied to Professor Biffen the starting point for the combination of cropping power with strength, which characterises his "Yeoman" wheat. When well grown in the Eastern counties flour made from "Yeoman" wheat alone is as strong as the ordinary mixture made up by the miller for household flour. The limit of improvement in this direction has not yet been reached, and as new varieties containing this quality of strength are raised, the country miller may be rendered independent of foreign wheats.

Our Wheat Supplies.—Prior to the War we only grew one-fifth of the wheat we consumed. The rest came from North and South America, Russia, India and Australia. Some of these foreign supplies have been entirely cut off, and though America has responded to the call by increasing her wheat acreage during the War to an extent sufficient to feed Western Europe, the total wheat acreage in the world is still perilously short. There has been a general withdrawal of labour from the land, and with increasing prosperity many of the Oriental countries are increasing their consumption of wheat. For the next year we are safe enough, because a considerable "carry over" in North America coincides with an exportable surplus from India and Australia and a good crop in Argentina. But the permanent position is by no means assured, and unless more land is put under wheat a bad crop in one or two of the exporting countries, such as always comes at frequently recurring intervals, would create a serious scarcity of wheat in the whole world. As a national insurance it is a matter of the first necessity to grow more wheat at home. It is possible to extend our acreage; it is also possible to extend our production on the existing wheat land. In both cases, however, better skill and more knowledge are needed. The country, therefore, must not grudge expenditure upon the attainment of knowledge, because on knowledge hangs our assurance of a progressive food supply in the future.

PLANT BREEDING WORK AT ABERYSTWYTH.

PROFESSOR R. G. STAPLEDON, M.A.,

Plant Breeding Institution, Aberystwyth.

Introduction.—An increased output of home-grown food implies not only intensive farming but also the use of the best possible strains of plants and of the highest class of animals. The conditions in Wales, with its average high rainfall and not inconsiderable tracts of country under cultivation at altitudes of 600 to 800 ft. and with an appreciable acreage under the plough at elevations up to and occasionally over 1,300 ft., undoubtedly call for special strains of plants if crop production is to be maintained at a reasonably high level. It is satisfactory, therefore, to be able to state that owing to the foresight of Sir Laurence Philipps, Bart., of Llanstephan House, Boughrood, Radnorshire, who generously provided an endowment for the purpose, it has been possible to start a Plant Breeding Station with the avowed aim of improving and breeding strains of agricultural plants suitable for Welsh conditions.

The new Station is attached to the University College of Wales at Aberystwyth, and its work is, of course, closely associated with that of the Agricultural Department of the College. The activities of the Station commenced in May, 1919, with the appointment of a Director and a Research Assistant, who took up their duties immediately; a Kew-trained gardener joined the staff shortly afterwards. The Station has now been recognised by the Ministry of Agriculture as a Research Institution entitled to grants-in-aid from the Development Fund, and by virtue of substantial grants towards maintenance and salaries of fully qualified research workers it has been possible further to augment the scientific and outdoor staff for the current year's working.

Suitable laboratory accommodation has been arranged for in connection with the new Agricultural Buildings now nearing completion. Fortunately, the College was able to acquire for the Agricultural Department a disused foundry near the railway station at Aberystwyth. The work of alteration was taken in hand last summer, and the laboratories for the Department of Agricultural Botany and the Plant Breeding Station were in use as soon as last October, and are now

completely finished. The laboratories (see Plates I and II), are designed for each of three separate purposes:—

(1) A large laboratory primarily intended for students and capable of accommodating over 30 persons. The room is lit from both sides, two tiers of benches running from end to end on one side, and one bench on the other. A series of incubators for the purpose of seed testing occupy the body of the room; and the single bench, which is seldom required for classes, is used by laboratory assistants concerned with seed testing and other routine work in connection with the Plant Breeding Station. In the Easter and Summer Vacations the extensive benches in this laboratory are of considerable service both in preparing for the sowing of plots and in the handling of the harvests.

(2) Three special laboratories for the use of the staff of the Station. Two of these are arranged to give the maximum of bench and table space, and each is allocated to a branch of the work in hand. Both are equipped with special cabinets for filing seed samples, and with tiers of trays to facilitate the systematic handling of numerous samples while under investigation. The third is a small laboratory where the finer work, such as the preparation of microscopical slides, will be undertaken. The arrangement is based on the allocation of the laboratories to different aspects of the work rather than to individual investigators as such.

(3) Private laboratories have also been provided for (a) the Adviser in Agricultural Botany, and (b) the Lecturer in Agricultural Botany: the latter laboratory has been equipped for pathological work.

In addition to the laboratories a drying room and a gardener's workroom have been arranged for at the Agricultural Buildings. The design of the former is rendered apparent by reference to Plates III and IV. The room is 18 ft. high, the roof being reached by narrow passage ways; thus two tiers of hanging pegs are available. Racks are arranged around the sides of the room on the floor level; they are used for the dual purpose of making hay off small plots or from individual plants, and for drying heads of seed on shallow trays.

It was decided that the drying room should be at the laboratories rather than at the garden, so that use could be made of the central heating, and also because the room is only intended to deal with small "lots", which would in

most cases in any event, sooner or later, have to come to the laboratories. A room of this kind was considered essential, owing to the uncertainty of the seasons in the West, and it has proved of great value during the present wet summer.

The gardener's room is designed for dealing with the threshing and cleaning of small and special "lots" of seed such as in many years may be "made" or partially "made" in the drying room. Special tackle run off a $\frac{3}{4}$ h.p. electric motor is being used for this purpose. The label writing, preparation of pollen-proof capsules, and such like work, will also be undertaken in this room.

The College Authorities were able to place about 4 acres of garden ground at the disposal of the Station at its inception. This ground was broken and turned into allotments during the War, and has since been converted into very satisfactory gardens. It has the great advantage of being within about 15 minutes' walk of the laboratories. In addition a 13-acre arable field within easy reach of the gardens was taken in hand for larger trials. A farm of 92 acres has now also been acquired for the sole use of the Plant Breeding Station. The farm practically adjoins the experimental field referred to above, and will be available for the work of the current session.

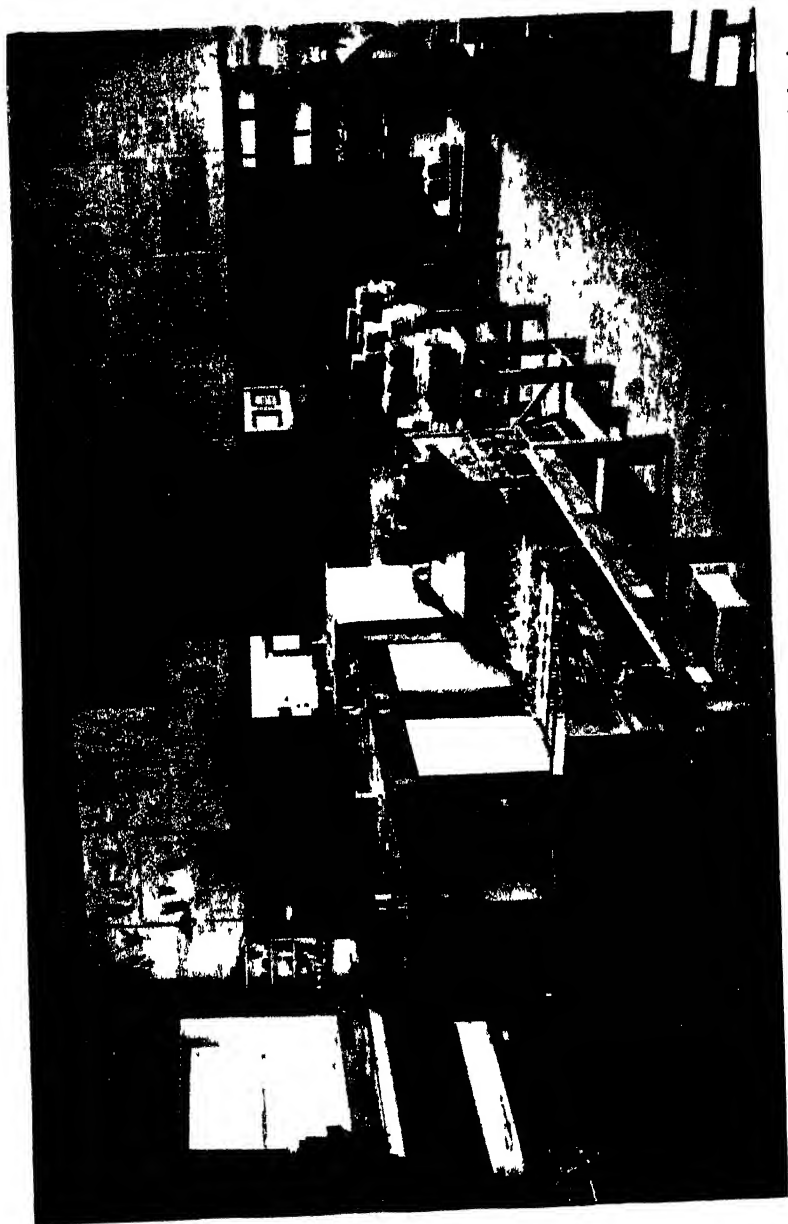
The preliminary arrangements necessary before exhaustive investigations could be proceeded with have thus been completed within eighteen months of the foundation of the Station.

Before entering into details as to the manner in which the gardens have been laid out it is desirable to review briefly the work already in hand, and to indicate the lines upon which it is proposed to develop the activities of the Station.

Herbage Plants.—A characteristic feature of the agriculture of Wales and the West of England is grassland; not only permanent, but also temporary grass.

Leys of 4 to 6 years' duration are commonly employed in the rotation. It was decided, therefore, to devote very considerable attention to the problems connected with the improvement of herbage plants, the more so since this is an aspect of economic plant breeding which has not been exhaustively investigated in this country.

In dealing with grasses and clovers numerous difficulties immediately present themselves. It is essential, for instance, to be able to study single plants, and with grasses sown in drills or broadcasted it is not easy to separate out individual



Closed Hanson Incubator - are behind

PLATE I.—Showing the Seed Testing Incubators in the large Laboratory
and Copenhagen Tanks in front



PLATE II.—Showing corner of the chief Laboratory of the Plant Breeding Station. Filing Cabinets for seed samples and tiers of shelves for samples under investigation are seen against the wall. A series of 6-foot tables run through the middle of the room and there is also a bench against the windows (not shown)

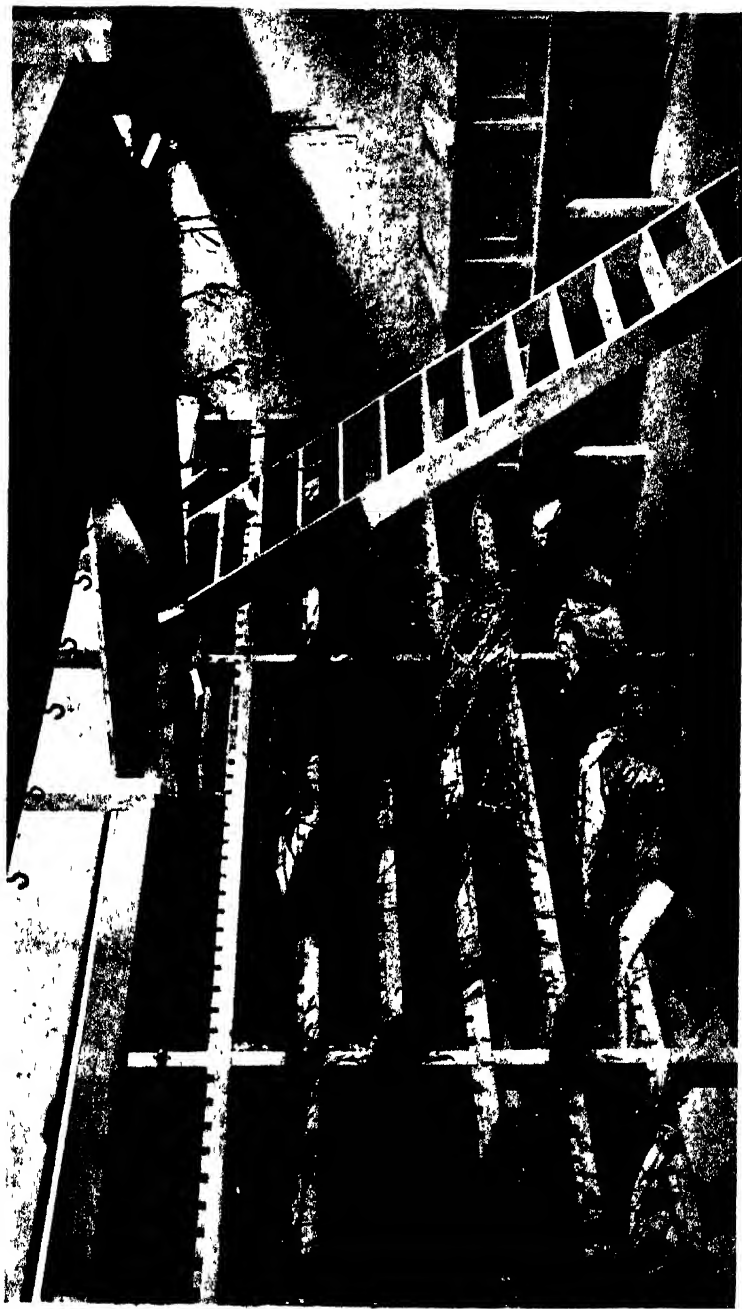


PLATE III —Showing the arrangement of the floor section of the Drying Room. Hay is being made of samples of Cockfoot on the racks. pegs for hanging samples are shown on the upper passage ways and seed bins against the wall

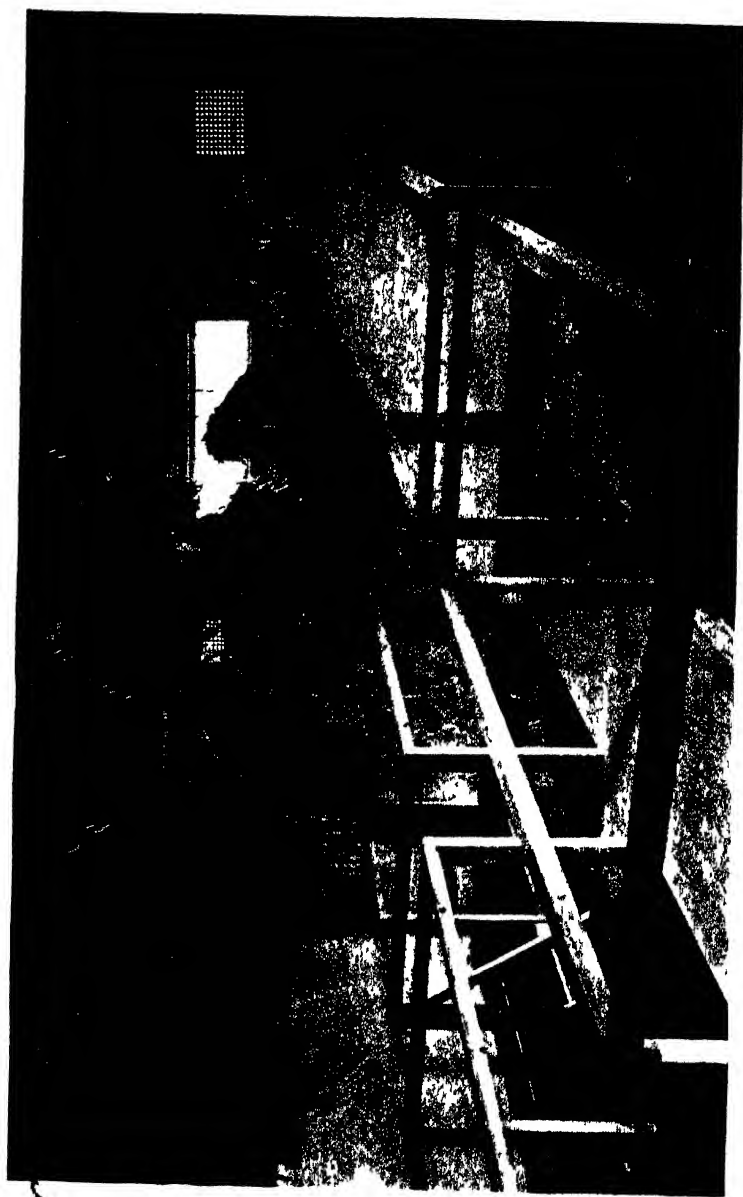


PLATE IV —Showing the arrangement of the roof section of the Drying Room. Note the narrow passage ways, with hand rails and pegs for hanging samples on the roof

plants. The method of sowing in boxes and subsequently planting out employed in Denmark has therefore been adopted. The box culture section in the main garden is shown in Plate V. This consists of brick-sided trenches 12½ in. deep, and 3 ft. 7 in. broad. Strong boxes of a convenient size for lifting are used; when watering becomes necessary the trenches are flooded in sections. The trenches are placed in a large mesh cage sufficient to keep out wood pigeons (which are a particular nuisance in the district) and other large birds. Special "lots" are started in this manner, both for garden and small-scale field trials, the plants being put out in spaced rows with ample room between them.

A further difficulty has to be contended with in the form of "volunteers" of the species under investigation. There is the danger that such seed may be in the soil and so contaminate the seedlings, and it is essential, when dealing with pedigree cultures, that this undesirable seed should be killed. Arrangements are being made to provide a suitable plant to heat sufficiently the soil used for the boxes so as to kill "volunteer" seeds before sowing; in the meantime a useful method applicable to such small lots of seed as those from a single head of a grass or a clover has been under investigation during the past season. The method consists of starting the seed on an incubator in a greenhouse, and pricking off the germinated seeds and planting in boxes in spaced rows. It has been found that with careful handling the minute seedlings transplant quite satisfactorily. This plan affords the additional advantage of safeguarding germination and providing a germination test.

Work on herbage plants, the great majority of which are cross fertilized, demands special precautions and methods with a view to regulating pollination. The question of pollen-proof cages and capsules is exceedingly important and especially difficult when working in a wet climate, and investigations are being made as a preliminary to the more serious study of the fertilization affinities of the commoner grasses and clovers.* It was early apparent that all pollination work and studies would have to be conducted under grave disadvantages, not only on account of the common occurrence of wet weather during May, June and July, but also because of the strong winds and gales which are a feature of the prevailing climatic

* It will be necessary to ascertain whether under the climatic conditions prevailing in Wales the findings of Continental and American workers apply to the grasses and clovers under investigation.

conditions. It was decided, therefore, to resort to glass as an assistance. A large span house with cage and trolleys has now been erected to facilitate this aspect of the work. The house (unfinished) is shown in Plate VI. This illustration also shows the large cage, the bottom part of which contains the box culture trenches; the upper part is small mesh, and is used for cereal work. Experimental pollen-proof cages are also shown, and to the left, on the grass bed, are pollen-proof capsules covering panicles of cocksfoot.

The herbage plant work aims not only at improving the common grasses and clovers already in agricultural use in Wales but also at introducing herbage plants which are not at present used, or if so only very slightly, in this country and at examining the possible usefulness of some of these plants as parents for hybridization.

With a view to this latter end small scale trials are first set out in the garden, and followed up on a larger scale with plants which show any promise. An interesting trial embracing about thirty species was sown down during the spring.* The course adopted is to sow half of each bed in drills *in situ* and to make up the remainder of the bed with spaced single plants obtained from the boxes. It is naturally to be expected that the great majority of the species tested will prove to be quite useless; and it is interesting to record, therefore, that a few species in particular have shown to sufficient advantage to merit further investigation and trial. These species are (1) a variety of *Trifolium subterraneum*† which makes unusually robust and rapid growth, (2) *Phalaris nodosa*, (3) *Danthonia pilosa*, (4) Teff grass (*Eragrostis abyssinica*), and (5) Hairy Vetch (*Vicia villosa*).

(1) *Trifolium subterraneum*.—This is certainly a remarkable plant. In the garden it produced a dense growth, and within ten weeks of sowing, rows 15 in. apart were completely filled up, some of the runners being over 18 in. long. Sown on 29th April, 1920, it flowered to some extent in August; sown on 30th June, 1919, it did not flower in the autumn, but

*Thanks are due to Dr. Taylor, Chief of the Bureau of Plant Industry, U.S.A., and to Messrs. Donaldson, of Edinburgh, who obtained a considerable number of special seeds for the Station. Other varieties were obtained from Messrs. Vilmorin Andrieux et Cie., of Paris, and Messrs. Haage and Schmidt, of Erfurt.

† The seed was obtained through Messrs. Donaldson, who stated that it is used in Australia. Further and exact information is being sought, but has not yet been obtained.

The seed would seem to be expensive (15s. per lb.); if the plant ultimately proves to be of value the preliminary trials conducted suggest that seed production may possibly be quite feasible in this country.



PLATE V.—Showing the Box Culture Section in the garden. Note the arrangement of the boxes in the trenches.



PLATE VI—Showing the *C. acanthus* in the chief garden. Note the box culture trenches at the bottom of the large cacti (cactus growing in the upper section). The latex-plant greenhouse is shown in course of erection. To the left are to be seen experimental pollen pits of *C. acanthus* and on the right pollen proof capsules covering cockfoot panicles.

maintained growth more or less all through the winter and produced more winter foliage than did the red clovers. It flowered and set seed the following spring. The plant is being further tested in rod plots sown at various rates alone and in competition with red clover and with ryegrass and cocksfoot. The evidence so far obtained suggests that the plant may be particularly valuable for providing an autumn bite on stubbles, as when sown under corn it does not make tall growth.

(2) *Phalaris nodosa*.—This plant was sown in April, and had made luxuriant growth by August, the foliage being abundant and the leaves broad. The grass is grown in South Africa, and according to Bews it gives rich pasturage, being both hardy and frost resisting.*

(3) *Danthonia pilosa*.—Seed sown at the end of April produced good plants in August, when one or two sent up flowering heads. The foliage is dark green, forming dense little clusters, and the leaves are rather thick and narrow. The seeds of this grass would seem to be successfully employed in mixtures in New Zealand.

(4) Teff Grass (*Eragrostis abyssinica*).—This was tried in 1919, and again this spring. It was thought that it might be useful as a late spring-sown catch crop. In 1919 it was sown on 3rd July, and had made quite good growth by the end of August, but was browned by the first slight frost; sown in June and again in July, 1920, under the wet conditions obtaining, the plants never started into growth, the contrast between the two seasons being very noteworthy. This is thus a plant which may possibly repay further trial in the east and south of England, but is obviously of no value in Wales. Bews states that this annual grass is successfully grown for hay in the High Veld areas of Natal and the Transvaal.

(5) Hairy Vetch (*Vicia villosa*).—This plant, when sown in garden trials, showed itself capable of producing a considerably heavier crop than the common vetch. As Lawson† states, it comes away slowly at first, but when fully grown produces a very heavy crop. The seed is at present much more expensive than is that of common vetch, but if seed could be grown at all economically in this country the plant should be again extensively tried.‡ Field scale trials are being arranged this autumn, since it would appear that

* Bews, J. W., "The Grasses and Grasslands of South Africa."

† "Vegetable Products of Scotland."

‡ Piper ("Forage Plants and their Culture") states that Hairy Vetch was cultivated in England in 1815 and in Scotland in 1833, and that it is now (1917) becoming more and more appreciated in America.

spring sowing hardly gives the plant a sufficiently long growing season.

Of the plants that have given convincingly negative results, the following may be mentioned:—Berseem (*Trifolium alexandrinum*), which did not come into flower, and produced much less than Crimson Clover; Sulla (*Hedysarum coronarium*), which only grew sufficiently to produce a few pinnatifid leaves; Chick Pea (*Cicer arietinum*), which made very slight growth and did not come into flower. Rhodes Grass (*Chloris gayana*), a native of South Africa, a grass which has received considerable attention in Australia; Sudan Grass (*Andropogon sorghum-var*); and Johnson Grass (*Andropogon halepensis*), all made negligible growth.

With regard to the improvement of existing strains of the grasses and clovers in common use, it appeared necessary, as a preliminary, to conduct exhaustive nationality and place-of-origin trials with the commercial seed at present available, with a view to making a critical study of the characteristics of the plants, and also in order to ascertain the possibility of selection from the best commercial strains and eventually to be in a position to institute comparisons between the Station's selections and the most successful nationalities of imported seeds. Both field and garden plots have been formed. In 1919 about 266 small garden trials, dealing with red clover, cocksfoot and ryegrass were sown; this spring a further 250 garden plots were arranged; tall oat grass, rough stalked meadow grass, meadow fescue and white clover were also included, and in addition 310 rod plots* have been laid out in the field.

It is premature to discuss the results so far obtained, and final conclusions cannot be drawn until the trials have been repeated and conducted for a number of years, especially as the chief aim of the investigations with herbage plants is to obtain strains of uniform productiveness for 4- to 6-year periods.

In the matter of red clovers, however, it is of interest that the late flowering reds, certain strains of Montgomery red clover, and Cornish marl grass clover, have given on the average the best results in the first year. Cornish marl grass clover appears to be decidedly distinctive, and has the reputation of being a truly perennial plant.† Of the foreign clovers the most

* Rod plots are always sown on the basis of a uniform and appropriate number of germinable seeds to the acre.

† This clover is grown for seed in a restricted area near Wadebridge, and would not seem to be at all generally used except quite locally.



PLATE VII.—Showing stems of Red Clover attacked by a *Glomerulosis* disease. Note that the stems are almost completely girdled by diseased tissue, and several of the petioles are broken.

noteworthy fact has been the very poor results obtained from Italian seed, due chiefly perhaps to the incidence of a disease (due to fungus *Gloeosporium* sp.). This disease was first noticed on the Italian beds, and the greatest damage was caused to the clovers from this source.

The disease in question is under further investigation. The following brief notes are supplied by Miss K. Sampson, M.Sc., who has kept records of the incidence of disease on the various plots:—

The *Gloeosporium* disease of red clover is recognised by the characteristic discoloured areas on the leaf-stalks and flowering stems. They may be $\frac{1}{4}$ to $1\frac{1}{2}$ in. long, and nearly girdle the stem or petiole. The margin of each diseased area is black, and the centre is brown and dry or contains a central cavity extending to the hollow of the stem. As the stem is often completely girdled by diseased tissue and breaks at the diseased patch, dead and shrivelled leaves and stems are a conspicuous feature of a clover bed attacked by this disease. (See Plate VII.)

The fungus *Gloeosporium* sp. is spread by microscopic spores produced in minute colourless pustules which can be seen when the diseased areas on stems and petioles are examined under a strong lens. Every diseased patch is thus a centre from which the fungus may spread to new leaves and stems. It is significant of the serious extent to which the disease may spread that two beds of red clover from Italian seed examined in July, when neighbouring beds were in full flower, showed only one flowering stem in each bed, all others having been destroyed by the attacks of this fungus.

The *Gloeosporium* disease was first noticed on the red clover plots at the end of April, 1920, and observations were made during May, June and July. Although the disease was widely distributed among the beds there was a marked difference in the extent of the damage suffered by clovers of different origin. As has been indicated above, the beds from Italian seed were most severely attacked, and in two instances practically destroyed. By the middle of July serious damage had been done on beds of English, Brittany, Canadian and Wisconsin clover, and the attack was only slightly less severe on beds of Chilian red clover. The most striking feature arising out of the observations was the relative freedom from disease of late flowering red. Throughout the season this variety presented, in the green healthy appearance of the

foliage, a marked contrast to all other varieties, with the exception of Cornish marl, which, although somewhat different from late flowering, is none the less late to flower. A similar disease of red clover, due to the fungus *Gloeosporium caulivorum*, is known on the Continent and in America, where it has frequently been the cause of serious damage to the clover crop.

The small scale nationality trials have proved interesting in several other directions.

It has been noted that tall oat grass grown alone gives very large first hay crops. The following comparative figures show the average yields of hay from small pure plots cut on 1st June. The percentage of leaf of the hay is also shown:—

	Comparative Hay Yields.	Percentage of Leaf in the Hay.
Timothy	100	43·5
Tall Oat Grass	96	42·0
Perennial Ryegrass	92	18·0
Italian Ryegrass	80	24·0
Cocksfoot (Commercial)	63	19·0
Meadow Fescue	49	46·0

It will be noticed that perennial ryegrass cut heavier than Italian; this is doubtless due in part to the fact that Italian ryegrass matures somewhat later than perennial, but the chief difference is probably owing to the excessive relative "stemminess" of perennial. It was noteworthy that Italian ryegrass stood much better than did perennial, isolated Italian plants remaining standing in perennial beds when the whole of the perennial had gone down. Cocksfoot also stands well; tall oat grass and Timothy are moderate in this respect; while late flowering red clover goes down very much worse than broad red, probably because the plant is taller and produces more numerous lateral branches, especially towards the upper third of the stem.

It is well known that Westernwolph's Italian ryegrass makes more rapid growth than does ordinary Italian. This fact was amply confirmed by the trials at the Station. A number of Italian strains of which the seeds were supplied by the Ministry of Agriculture were included in the trials. It was noticed that the Italian vetches (*Vicia sativa*) produced in twelve weeks very appreciably less growth than did vetches harvested in Essex; that the lucerne showed poorly in comparison with seed from Provence; and that the sainfoin did

not compare favourably with plots sown with Gloucestershire

The foregoing account refers to investigations which are regarded as necessary preliminaries to the actual breeding work with herbage plants. The plan adopted with reference to breeding grasses and clovers follows closely that at present employed at Svalöf and in Denmark, and aims at selecting from promising indigenous plants. It is interesting to note that this procedure has in the past actually been put into practice in this country, and with apparently good results. For some unaccountable reason, however, it has never been followed up and made the subject of long continued and exhaustive scientific inquiry, and no proper precautions have been taken to maintain the purity of such strains as have been selected. Thus Peter Lawson and Son, writing in 1852,[†] refer to and give particulars of no less than twelve leading "sorts" of perennial ryegrass, but to-day samples offered under well-known names such as "Devonshire Evers" and "Pacey's" seldom appear to have any very distinctive characteristics, the name, but not the strain, as such, having been handed down to the present generation of farmers.

Two methods are now being employed at Aberystwyth, namely, the collection of seed and the digging up of plants *in toto* and bringing them to and planting them in the gardens.

As a first step the seed of indigenous grasses was collected more or less in bulk from several different districts.[‡] The object was merely to ascertain whether indigenous seed (without special selection) compared favourably or the reverse with the ordinary commercial and imported stocks. Cocksfoot, tall oat grass, crested dog's tail, meadow foxtail and Timothy were in the first instance collected and sown, and perennial ryegrass, tall fescue and rough stalked meadow grass have since been added to the species thus brought under preliminary investigation.

(To be concluded next month.)

* It must be pointed out that neither lucerne or sainfoin have grown in the district, and it is possible that the Italian lucerne and sainfoin plants may prove to be relatively hardy and lasting.

† *Ibid.*

‡ This work was commenced under the auspices of the Technical Division of the Food Production Department during the summer of 1918. The Station therefore owes it to the Ministry that a considerable amount of seed was available and made over to the Station for sowing in the gardens in 1919. Thanks are due to Dr. Brenchley, Mr. Fryer, Mr. Jenkin, Miss Sampson, Mr. H. H. Dunn and others who helped in the original collection of seed for the Food Production Department.

THE BRITISH DAIRY FARMERS' ASSOCIATION.

F. J. LLOYD, F.C.S., F.I.C.,

Consulting Chemist and Dairy Bacteriologist, British Dairy Farmers' Association.

It is not generally realised what was the condition of the milk supply of London as recently as 70 years ago, when nearly all the milk then consumed was produced by cows in London and its suburbs. Mr. E. C. Tisdall, an original and active member of the British Dairy Farmers' Association up to the time of his death, had himself milked the cows at Kensington Park Farm in the fields where the Albert Hall now stands.

The idea of bringing milk into London by rail appears to have come first to Sir (then Mr.) George Barham about 1860. By the year 1864 he had established the "Express Country Milk Co.," and when the outbreak of cattle plague in 1865 threatened a milk famine in London, it was largely through Mr. Barham's undertaking and his remarkable energy that such a disaster was prevented.

London, however, was growing rapidly, the demand for milk was increasing, and the difficulty and danger of producing it in town sheds were becoming more and more pronounced. Town and country were thus for once brought together in a common interest; for it must be remembered that no small number of the London dairymen at this period were essentially dairy farmers, possessing all the practical experience of their calling and also those business methods and habits which life in the metropolis engenders. It was to this rare combination in many of its original workers that the future success of the Association was due.

The feeling arose that those engaged in the dairy industry should associate more than had been possible in the past. After two years of agitation in the press, a meeting was held on 24th October, 1876, at a Metropolitan Dairy Show inaugurated by the Agricultural Hall Auction Co., Islington. At this meeting Professor (then Mr.) Sheldon read a paper to open a discussion on the desirability of forming such an association, and proposed that one should be formed, with the title "The British Dairy Farmers' Association." The resolution was carried unanimously, and a Committee was appointed to act on the terms of the resolution.

Objects of the Association.—The objects for which the Association was formed were summarised by the Chairman, Mr. John Coleman, at this meeting. He said that there was much to be discovered, and much knowledge to be spread abroad in connection with dairy matters, and that the best means of advancing the cause of dairy farmers, and enabling them the better to meet the demands made upon them by the public, was to establish an association which should bind them together for the mutual improvement of their industry. This was further enforced in the first issue of the *Journal* published by the newly-formed body in 1877, in the words: "It must be borne in mind that the Association exists for the improvement of dairy husbandry in Great Britain."

It is necessary to emphasise this fact, for many people seem to think that the Association was formed merely to hold a Dairy Show. This may partly explain why the Association has never been sufficiently supported by the dairy farmers of this country, nor its influence and true scope fully appreciated by the British Government during the 45 years of its existence.

Initial Work.—We may best judge of the intention of the promoters by studying their first efforts. Mr. J. P. Sheldon was asked and agreed to visit the Hamburg Dairy Show in March, 1877, with a view to writing a report on his visit. This report was published the same year in Part I of the first *Journal* of the Association.

The Government was early approached on the question of cattle disease, and research work was undertaken (*see* p. 644).

The Association decided to offer medals at the London, Frome and Kilmarnock Dairy Shows for the best cows for dairy purposes, the best exhibits of cheese and butter, and implements of merit for dairy purposes.

The subject of dairy education also received attention, and details were obtained of a Dairy Station formed in Bavaria with the object of assisting the dairy industry in that State. This action marks a step in the promotion of the dairy interests in this country by the encouragement of scientific and practical education in subjects related to the dairy industry.

That the primary objects of the Association should have been educational, using the word in its widest sense, is not to be wondered at when we study the names of the original founders. Foremost among them was the late Dr. Augustus Voelcker, whose scientific knowledge, wide acquaintance with practice and keen sympathy with farmers, enabled him to see the great need for

improved education and a proper training for those who contemplated taking up any branch of the dairy industry.

The desirability of holding a National Dairy Show had occurred to some of the original promoters, but it was not until 1878, two years after the formation of the Association, that the Committee held its first Dairy Show.

On 1st October, 1879, the Association was incorporated, and the Committee was then replaced by a Council. The members gradually increased, and at the end of 1879 the number was 360.

The influence exerted by a Society generally depends in large measure upon the impressions which the ideas of a few members make upon the body as a whole, and, as a corporate body, of being able to further these ideas more widely and more rapidly than could an individual. The Association has been fortunate in this way. Among the pioneers, Mr. E. C. Tisdall was destined to play a leading part, especially in the improvement of dairy cattle. The necessity for such improvement had long attracted his attention, and in a paper contributed to the second part of the first Journal he impressed upon dairy farmers that they should "breed a race of cows more consonant with their own interest and the requirements of the community."

These views were enforced by careful records of the daily yield of milk from each cow in a herd of 60. Such records, probably the first of their kind, attracted considerable interest, and in 1881 Mr. T. Higgin, of Liverpool, offered a challenge cup for the best dairy farm record, which was competed for in the following year. Since that time the Association has continued to impress upon dairy farmers the importance of records.

Simultaneously Professor Sheldon, by active propaganda work, was aiming at the improvement of methods of dairy farming. The results of his efforts were important, and the work has been continued by the Association.

Milking Trials.—At the first three dairy shows, the prizes appear to have been given to cows merely after inspection of the animals. In 1879 and 1880 milking trials were instituted, and a report on the results obtained was published. The trials have been continued ever since, modified or extended as experience dictated, and have thrown light upon many problems. They have shown the natural fluctuations in milk, the peculiarities of breeds and individuals, and the possibilities of improvement.

Conferences.—In 1885 it was decided to extend the educational work of the Association by holding Conferences in the

country to discuss matters of importance to dairy farmers. These Conferences have since been a regular feature of the work of the Association. People engaged in dairying have been brought together and enabled to discuss matters affecting their industry to their mutual interest. The practical and scientific man has had the opportunity of exchanging views, each learning from the other the directions in which possibilities of improvement might lie. The Conferences have not been confined to this country, but have been held in many parts of the Continent, thus enhancing their educational value and making them more than national in scope.

It is difficult to estimate the value of the Conferences. The pleasure of social intercourse, the excitement of new scenes and the sense of a holiday which absence from home and the daily task gives to each of us, has caused some people to regard them as pleasure trips. Their real value, however, has been educational, affecting not only individuals attending, but also, through printed reports, far greater numbers who were unable to attend. The Conferences, in fact, have had an important beneficial effect, of international magnitude, upon the dairy industry.

Education.—While the leaders were striving to improve the dairy industry, there were few signs that the rising generation were studying the progress which had been made. To encourage a proper study of dairy science and practice, the Association in 1887 offered to award a Diploma to each successful candidate, and an examination was held for this purpose. The results were not satisfactory, and in the following year a Dairy Institute for the instruction of pupils was opened near Aylesbury, Mr. John Benson being appointed Manager and Instructor.

Much of the progress of the last thirty years may be traced to these examinations and to the instruction given in dairying. The Institute became a centre which attracted the best ability and from which for many years the leading teachers in this country were sent out. Many of these themselves became trainers of new workers.

It was the presence of these numerous skilled workers in the dairy industry during the War which largely enabled the industry at home to survive the numerous and drastic changes which were imposed upon it.

No review of the educational work of the Association would be complete without reference to the invaluable service rendered by Dr. Augustus Voelcker. From the beginning of the Association's activities he urged the importance of the application of

science to the dairying industry, and his results in this direction have been considerable in developing the industry on the right lines.

Research.—The first efforts in dairy research undertaken by the Association were a series of experiments on the feeding of dairy cows, carried out on Lord Vernon's dairy herd in 1886. Three lots of cows, as nearly similar in all respects as possible, were selected, and it was found that the lot receiving 21 lb. per head per day of properly proportioned dry matter gave as good results as other cattle receiving respectively 29 lb. and 34 lb. per head per day. The experiments thus proved that the system of feeding then in vogue was costly and wasteful, and that an excess of food over and above what the animals can assimilate is wasted. Their influence was very great at the time, and has affected the feeding of dairy stock in this country ever since.

Some of the most valuable research work carried out by the Association has been in the domain of veterinary and bacteriological science. The diseases of cattle had, as already mentioned, attracted the attention of the original founders of the Association. Abortion was of widespread prevalence in 1879-80, and Professor J. Wortley Axe, of the Royal Veterinary College, investigated the matter at the request of the Association. In 1887 it was assumed that scarlatina was produced by milk from Hendon owing to an eruption on the teats of cows. An outbreak of diphtheria occurred at Framley, and was also attributed to milk. Into these and other outbreaks Professor Axe made, on behalf of the Association, careful and elaborate investigations. That the scarlatina came from cows was disproved, while the source of the diphtheria was traced to contaminated water with which the milk vessels were washed, and thus the disease conveyed from man to man.

Tuberculosis in cattle and its possible relation to the same disease in man, has been from 1887 a subject of growing importance. The view of the medical profession was that this disease was probably due to milk. This raised the question as to the prevalence of this disease in cows and of the bacilli in milk. Professor Axe made a careful investigation into the matter, and his results were published in the Association's Journal for 1899 (Vol. 14). They showed that the prevalence of tuberculosis in cows, and especially of the bacilli in milk, had been greatly exaggerated.

The medical profession also asserted that milk frequently contained pus, and was not fit for human consumption. The Associa-

tion had the matter thoroughly investigated, and a report on the results of the investigations was published in its Journal for 1910 and 1911. It was conclusively proved that what had been taken by superficial observers to be pus cells were normal cellular structures of healthy milk.

Work During the War.—After the outbreak of the War the work of the Association naturally declined. A show was held in 1915, but thereafter the shows fell into abeyance until 1919. At a public meeting of dairy farmers held at Westminster on 6th February, 1918, under the presidency of Lord Desborough, K.C.V.O., the following resolutions were passed unanimously :—

“ 1. It is desirable to discourage the slaughter of every healthy cow and female calf adapted for dairy purposes so as to ensure the utmost possible production of milk now and in the future.

“ 2. Cheese is the most perfect substitute for meat, hence all milk that can possibly be spared should be converted into cheese; and as the whey from cheese-making is best utilised when fed to pigs, the maximum number of pigs should be so fed, and to attain this end a necessary supply of offal, particularly from home-grown cereals, should be ensured.”

Had the policy indicated in these resolutions been adopted from the very commencement of hostilities this country would not now be so heavily in debt to others.

Such, in brief, are the foundations upon which the dairy industry of this country has been built up since the inception of the British Dairy Farmers' Association. It has been a natural process of evolution, and during the period vast changes have taken place.

From the commencement of its activities the Association has been impressing upon dairy farmers the necessity of improving dairy stock, of increasing milk production, of economy in feeding, and of skill in the manufacture of all dairy products. The War emphasised the need of attention to these matters.

By its thirty years' educational work the Association has taught those engaged in the industry how to obtain results far beyond what were previously thought possible; it has sent authorities on dairying to all our colonies, and has helped to promote dairy education throughout the British Empire.

The great help which the Association gave the country during the terrible years of War was not direct, but indirect. It had trained an army of skilled workers, many of whom were found

invaluable during the emergency in teaching, organising, and directing various branches of the Government's work. Owing to its activities, also, the country possessed many skilled dairy farmers who proved capable of carrying on under the most trying and often irritating conditions ever imposed upon any industry.

In production of milk for consumption there has been a constant endeavour to ensure quantity, quality and cleanliness. The methods of making butter and cheese have been completely revolutionised by scientific progress. There is still room for improvement, and great changes loom in the distance. Science must lead, practice will follow.

BREEDING DAIRY CATTLE FOR MILK PRODUCTION.

J. MACKINTOSH, O.B.E., N.D.A., N.D.D.,

*Research Institute in Dairying, University College,
Reading.*

DURING recent years attention has been repeatedly directed to the importance of increasing the yield of milk from the dairy herds of this country. The Committee on the Production and Distribution of Milk, in their Final Report,* draw attention to the steps which can be taken to reduce the cost of production and increase the profit to the farmer, and the Agricultural Sub-Committee, in dealing with the subject of the improvement of home breeds,† laid special stress on the possibility of obtaining better yields by improved breeding methods.

In order that a farmer may discover and dispose of his poorest and unprofitable milkers, it is essential that the practice of milk recording should be adopted, while a careful study of methods of feeding may result in a better yield from the same expenditure on food, but to maintain a herd at a high average yield it is necessary to ensure that the heifers reared to replenish the herd shall milk as well as, or better than, their dams. To attain this result, the utmost care must be given to the selection of the sire and to the choice of cows which are likely to produce heifers of the desired type and qualities.

The owner who wishes to improve his herd by breeding must first decide upon the type of animal he wishes to breed. Where the herd consists of cows of purely dairy type, such as Jerseys, Guernseys, or Ayrshires, the decision should not be difficult, but attention will need to be given to differences in type and size. Thus, in Jerseys the rent-paying farmer may well consider whether he should adhere to the Island type or try to develop a larger, hardier type, it may be less refined, but possessing equal or greater powers of milk production.

With cows of the dual-purpose type, the need for a clearly defined aim is even more necessary. As the objects for which the dual-purpose cow is kept are to give a good yield of milk annually (say 7,000 lb. to 10,000 lb), to lay on flesh readily on the best parts of the carcass when fattening, and to produce

* Final Report of the Committee on the Production and Distribution of Milk. (Cmd. 428), p. 13, par. 51 (2); p. 14, par. 59.

† Ibid., p. 29, par. 3.

heifer calves which will be satisfactory dairy cows and bull calves which can be reared into good steers, it is easy for the breeder to think so much of one of these objects as to neglect others.

There is considerable divergence of opinion as to whether the dual-purpose ideal is really attainable, *i.e.*, whether it is possible to combine in a family of animals the desired excellence in all directions. It is readily granted that individual cows possess the two qualities of large milk yield and fattening capacity to a high degree, but it is by no means proved that they possess the power of producing both heifers as good as themselves, and steers with the conformation and fattening capacity required in high-class beef animals. The practice of some breeders in selecting one bull from a family more noted for beef than for milk in order to increase the substance of the herd, and, later, selecting a bull from a dam with a high milk record in order to raise the falling milk yield, supports to some extent the point of view that it is almost impossible to breed dual-purpose cows from similar stock with any certainty.

It is sufficient here to point out that efforts to attain a dual-purpose ideal may lessen the chances of success in breeding for milk production, and it is suggested that the farmer whose main source of income is milk or other dairy products, should concentrate his attention on improving the constitution, the breeding powers and the milk yield of his herd.

The breeder should first make himself familiar with the principles of breeding, and consider their application to his own particular conditions. More rapid progress is likely to be made when a group of farmers in one district are working for improvement in the same direction and with similar material. Friendly co-operation and competition are invaluable, and in this direction Milk Recording Societies may do much in bringing owners of the same breeds or with the same aims in touch with one another.

Principles and Systems of Breeding.—The first principle to be noted is embodied in the familiar phrase "like begets like," and the second is that the progeny always show a greater or lesser degree of variation from their parents. A tendency has become evident in recent years to modify the first phrase to "like tends to beget like," and to amplify it to "like begets like or the likeness of an ancestor." Observation suggests that the latter is probably more correct. It has been the custom of some writers on breeding to speak of the inheritance by the immediate

progeny of characteristics possessed by their parents and the variation of progeny from the characteristics of their parents as antagonistic "forces," but a closer study of the problem has made it clear that, except in very rare cases, variations from the type, colour, &c., of the parents may be just as truly inherited from some ancestor as are the exact repetitions of features possessed by the parents. Further, variations may be either away from or toward the ideal aimed at. The former are undesirable and disappointing, while the latter constitute an opportunity for progress in the desired direction. The main problem for breeders is how to transmit the maximum inheritance of the desirable qualities possessed by the parents. The *uncertainty* as to the results which will follow from the mating of any two animals is one of the greatest hindrances to successful breeding.

The application to stock breeding of the discoveries of Mendel and his followers has thrown considerable light on the inheritance of such easily identified characteristics as colour of coat, colour of face, and presence or absence of horns, but little progress has as yet been made with other and more important characteristics, such as high and low milk yield, high and low butter fat content, capacity for fattening and tendency to leanness. Progress has been hindered by the absence of clean-cut dividing lines and the difficulties of identification, the slow rate of reproduction in cattle, the differentiation of sex and the impossibility of directly assessing the dairy qualities of bulls. These difficulties, however, should be overcome in time, and there are doubtless many present-day breeders who would be ready to co-operate in the collection of data on single or related points if some lead were given them in this direction. Mendelism may one day enable the dairy farmer to breed heavy-milking stock with the same certainty as the breeder of Aberdeen Angus cattle breeds black and hornless animals.

Systems of Breeding—The systems of breeding adopted are usually described by one or other of the terms crossing, grading, in-breeding, or line-breeding.

Crossing usually describes the mating of animals of distinct breeds, *e.g.*, Shorthorn with Jersey. The first cross between some breeds is often a popular and useful commercial animal, combining to some extent the desirable characteristics of the parents. At the same time, the introduction of the characteristics of another breed must increase the uncertainty as to the qualities which will appear in individual offspring, particularly in the second generation. Crossing, therefore, by

increasing the tendency to and possibility of variation, cannot be a successful means of improving a herd. Crossing is sometimes applied to the mating of animals of different types or families within a breed, and the result in this case is similar; the first cross often shows a combination of the qualities of the parents, but in later progeny the greater tendency to variation increases the uncertainty as to the inherent qualities of the progeny.

The term "grading" is in common use in America, and describes the continued mating of cows of a nondescript type with pure-bred bulls of some breed having the desired qualities. This method has been largely used in the past in building up several of the pure breeds of the present day. The scheme of the Dairy Shorthorn Association for the registration of the progeny of pedigree bulls out of cows of approved type embodies the principle of grading. This system offers the surest means of improvement where the owner of a herd of cows of mixed ancestry cannot see his way to dispose of his herd and replace it by cows of a pure breed.

In-breeding is the mating of closely-related animals, *e.g.*, sire and daughter, dam and son, and is the opposite of crossing. When this system is followed, there is great probability of the appearance in the progeny of the characteristics of the parents, and small likelihood of variation from the desired type. It is the surest and speediest of all breeding methods for fixing the characteristics which are desired, and it has been a predominating influence in the building up of most of our present-day breeds.

In contrast to its power for good, in-breeding, carried on unwisely, may cause disastrous results. Loss of size, constitutional vigour and breeding powers have in some notable cases followed from persistent in-breeding, and at the present day the practice of this system is uncommon.

Line-breeding describes the mating of animals that are more or less distantly related to each other. It might be called a modified form of in-breeding, because it embodies the same principle—that of concentrating and fixing family type and qualities. At the same time, the degree of relationship is not close enough to cause any serious risk of the development of the bad effects of in-breeding. This system is extensively followed in most of the pure breeds, and has given most satisfactory results. Close line-breeding would be exemplified by the use of two sires from the same family, each being mated with the

daughters of the other; this method is only practicable where a fairly large herd is kept and the bulls may be retained with safety. The mating of successive bulls from the same family with the progeny of each preceding sire would illustrate more distant line-breeding, and the adoption of this method is within the power of the average dairy farmer.

Pedigree and Its Uses.—Pedigrees provide information on the ancestry of individual animals, and are of incalculable value to all breeders. It is only by a study of pedigrees that a breeder can obtain the information necessary to enable him to follow a system of line breeding. The description of a pedigree usually given, however, is incomplete and misleading. It is customary to trace the descent only through the female side, and often an animal is described by a family name when it traces its ancestry on the female side to some famous cow, although this cow may be only one of four great-grand-dams. The dam and grand-dams of the sire are just as important as the dam and grand-dams of the dam.

It is also most desirable that the statement of pedigree should be supplemented by reliable information as to the dairy qualities of the dams and the dairy prepotency of the sires. In this respect, milk records meet a great need, and the breeder would be helped materially if a uniform method of stating milk yields were adopted.

Definition and Measurement of Dairy Qualities.—Some definition of the desired dairy qualities is first necessary. Five may here be mentioned:—(a) large milk yield; (b) persistency of milk yield; (c) high milk fat percentage; (d) regular breeding powers; and (e) good constitution.

Of these qualities, (c), (d) and (e) are possessed, often to a high degree, by cows of beef breeds. They are not confined to the dairy breeds, but are included here in addition to the specific dairy qualities of a large and a persistent milk yield, because they are essential in first-class dairy cows of any breed.

It is next desirable to ascertain the extent to which these different qualities are related. Some information on the first four points has been collected through the agency of milk-recording societies, and the development of this practice should enable valuable data to be obtained. Milk recording, as carried out in England and Wales, collects information on the quantity and persistence of milk yields (a) and (b), and, where the cows remain in recorded herds, on breeding powers (d). Only in rare instances is information collected on fat percentage (c), and this

defect lessens the value of the work of the societies as an aid to the study of the inheritance of dairy qualities and to breeding in general. With regard to constitution (e), it may be inferred that no cow will give high milk yields and breed annually for, say, five or more years unless she possesses a very sound constitution, but the maintenance of constitutional vigour is closely associated with conditions of rearing, housing, feeding and the risk of incurring infectious or contagious disease. The question of feeding is important, since a heavy milker may break down after a few years if she has been poorly fed.

With regard to the correlation between the other qualities, the opinion is commonly held that a large milk yield is usually associated with a low percentage of fat, and *vice versa*, and that heavy milkers are less regular breeders than those giving lower yields. The actual correlation between these and other points can only be arrived at after careful study of a large amount of information, but the breeder is not so much interested in the degree of relationship found in a large number of animals between, say, large milk yield and high fat content, as in the discovery of individual animals which possess *both* these qualities. If it be a general rule that high yields are associated with low fat content, it is the *exceptions to the rule* that form the breeder's opportunity for the improvement of his herd. Such exceptions are fairly numerous.

In this connection it is important to record the conclusion of Professor Wilson,* after the study of several thousands of records of Ayrshire cows, that the inheritance of quantity and quality—high yielding capacity and fat percentage—are independent of each other. It should, therefore, be possible to unite in the progeny of selected parents the two qualities of large yield and high percentage of fat.

Inheritance of Dairy Qualities.—This conclusion leads directly to a consideration of the inheritance of dairy qualities. Can it be said that cows which are found to possess one or more of the qualities referred to pass these on unfailingly to their progeny? Every breeder knows his own disappointments in this matter. Cows with high records, even when mated with most carefully selected bulls, fail to transmit their qualities to their offspring, while others with moderate records have progeny which excel their dams. As illustrations of the uncertainty which is often met with, the following details, taken from the

* *Scientific Proceedings of the Royal Dublin Society*, Vol. XII. (N.S.), No. 35, July, 1910.

records of the herd of non-pedigree Dairy Shorthorns at the University College Farm, Reading, may be interesting:—

Dam.	Daughters.	Grand-Daughters.
ROSE (No. 16) 7 L.P.—9125* lb. 45·7 wks. 11 wks.	ROSAMOND (No. 47) by "A" 5 L.P.—11397 lb. 50·6 wks. 9·6 wks. ROSABELLE (No. 49) by "B" 4 L.P.—7098 lb. 41·2 wks. 9·8 wks. ROSEMARY (No. 55) by "C" 2 L.P. 8003 lb. 42 wks. 9 wks.	ROCK ROSE (No. 58) by "C" 3 L.P.—6058† lb. 36·3 wks. 15 wks.
FILLPAIL (No. 28) 1 L.P.—5036 lb. 37 wks. 8 wks.	FILLPAIL (No. 46) by "A" 1 L.P.—1083 lb. 13 wks.	FILLPAIL (No. 57) by "C" 3 L.P.—7792 lb. 40·6 wks. 12·7 wks. BELINDA I. (No. 50) by "C" 1 L.P.—4191 lb. 29 wks.
BELL (No. 7) 2 L.P.—8225 lb. 43 wks. 13 wks.	BELL (No. 41) by "A" 6 L.P.—9891 lb. 45·8 wks. 15·3 wks.	BELINDA II. (No. 61) by "C" 1 L.P.—3468 lb. 32 wks. BELLA (No. 67) by "D" 1 L.P.—2063 lb. 25 wks.

"A"—a pedigree Dairy Shorthorn bull and sire of heavy milking stock (see p. 655).

"B"— " " " "

"C"— " " " " and the sire of stock giving good yields (see p. 655).

"D"— " " " " and the sire of stock giving fair yields.

The figures under each cow show the number of lactation periods, the average milk yield, the average number of weeks in milk and the average number of weeks dry.

* 2 quarters only for 5 lactation periods.

† 3 " " 2 " "

The progeny of the cow Rose (16), though by three different sires, have been very good dairy animals; one of them, Rosamond (47) by bull "A," especially so. The daughter of Fillpail (28) by the same bull was a complete failure as a milker (see Fillpail (46)), but the daughter of Fillpail (46) by bull "C" is an excellent cow.

Bell (7) was a good cow, and her daughter by bull "A" was even better. The latter's daughters, however, have been disappointments, though two of them were by bull "C," the sire of the good cow Fillpail (57).

The system of breeding followed in the herd from which the above details were obtained partakes more of grading than of any of the other systems described, and is fairly representative of the methods followed by the progressive dairy farmer. The degree of uncertainty as to inheritance of these qualities is probably less in some pedigree herds where a line-breeding system has been followed, and also less in the single purpose dairy breeds, than in those which claim dual purpose qualities.

The experience of breeders, nevertheless, has made it clear that cows which are good dairy animals do not necessarily have the power of passing on their own good qualities, either to their female or male progeny. This leads to a most important conclusion—that the *ability of a cow to transmit* its productive qualities is *distinct from the possession of* these qualities. We may therefore add another to the list of dairy qualities already given—(f), ability to pass on productive capacity to the progeny. From the breeder's point of view, this is the most important of all qualities, and if, in addition to the possession, to a more or less marked degree, of those qualities previously mentioned, the animals possessing it can be identified, some real progress has been made towards "certainty" in breeding.

Breeding Value shown by Progeny Records.—Up to the present the only method whereby the possession of such prepotency can be discovered is by a study of the actual records of the *progeny*. With dairy stock, this requires a much longer time than with beef stock. It is possible in two breeding years to ascertain with a considerable degree of certainty the quality of the progeny of a beef cow, and still more so of a beef bull. With dairy stock, however, until external appearances can be more accurately interpreted, three or four breeding years must pass before the milk records of the progeny show the actual powers of transmission possessed by their parents. In the case of cows this delay is not serious, but with bulls it means that, as a rule, the sire is slaughtered some time before his real powers as a getter of dairy stock can be known.

In herds of pedigree stock, bulls are frequently retained until well on in years, but in the past in this country it has not been the practice to determine the breeding value of such bulls by a study of the records of the progeny. It is quite probable that some such bulls have been retained because of their dam's or their own showyard record, or for other reasons which have no appreciable bearing on the transmission of dairy qualities.

There is some indication that this new point of view in the

judging of dairy bulls is gaining ground, particularly among Friesian breeders, but it is so important that it deserves widespread publicity. This should lead to a fuller realisation of the very true saying among farmers, that "the bull is half the herd."

For the purpose of obtaining a progeny record of a bull, it is necessary to have the milk records of the dams as well as those of the daughters, and the breeding value of the bull can be judged by the difference between the average record of the former and of the latter. To illustrate this important point, the progeny records of two bulls used in the herd at the University College Farm are shown below:—

Progeny Records of Bull "A."

	Dams	Daughters.
Number of Animals	8	8
Number of Lactation Periods	20	20
Average Yield per Lactation Period	8518 lb.	8479 lb.
<i>Loss per Lactation Period</i> ... ..	...	39 lb.
Average Lactation Period	46 4 wks.	44.3 wks.
Average Dry Period	10.0 wks.	11 3 wks.
Average Period between Calvings	56 4 wks.	55 6 wks.
<i>Gain between Calvings</i> ... ..	...	0 8 wks.

Note I.—The dams were a selected group of cows purchased from different places, and they show a remarkably high average yield.

Note II.—The 20 lactation periods of the daughters comprise more first and second periods than the 20 of the dams, and a larger proportion of these periods commenced during the summer months, thus handicapping the daughters. When these two conditions are taken into account, it can confidently be said that the daughters were superior to the dams, showing that Bull "A" possessed exceptional breeding value for milk production.

Progeny Records of Bull "C."

	Dams.	Daughters.
Number of Animals	9	12
Number of Lactation Periods	20	25
Average Yield per Lactation Period	8001 lb.	6468 lb.
<i>Loss per Lactation Period</i> ... ..	...	1533 lb.
Average Lactation Period	43 3 wks.	38 3 wks.
Average Dry Period	10 1 wks.	13.6 wks.
Average Period between Calvings	53.4 wks.	51.9 wks.
<i>Gain between Calvings</i> ... ..	...	1.5 wks.

Note I.—The dams include cows purchased for their apparent milking qualities, and several of the daughters of Bull "A." The average yield is notably good.

Note II.—The 25 lactation periods of the daughters include 5 more first and second periods than the 20 of the dams, and to a certain extent this handicaps the daughters. The season of calving gave no advantage to either group. The yields show that Bull "C" lacked the breeding value for milk production of Bull "A," but was nevertheless a useful dairy bull.

The above results show that Bull "A" was capable of siring female progeny which gave an average milk yield of 8,479 lb. in an average lactation period of 44.3 weeks, and which were at least equal to their dams in productive powers. The heifers and

cows got by Bull "C" averaged 6,468 lb. in 388 weeks, and failed to equal the record of *their* dams by 1,588 lb. These figures show conclusively that "A" was much the better bull for breeding purposes; he was, in fact, a bull worthy of a place in the best pedigree Dairy Shorthorn herd in the country. Unfortunately, following the usual custom, he was sold for slaughter before any of his progeny came into milk.

Progeny Tests of Bulls.—It is obvious that information from progeny records cannot be obtained in a short time, and that the extended use of bulls which have proved their value involves a change in practice in regard to the age to which bulls are kept. Under ordinary conditions, bulls are used for two to three years, and fattened for slaughter when three to four years old. So long as this practice is continued, the use of tested sires is impossible. With the larger breeds of dairy cattle, a bull will be four to four and a half years old before the oldest of his heifers calve down, and about five years old before they complete a lactation period. It may be possible to form a reliable opinion as to the *lack* of dairy qualities of these heifers by their poor udder development before, and low milk yield just after, calving, but, if the heifers promise well, it is not possible to distinguish between the good and the very good until well on in the lactation period. The progeny test, therefore, can only give information in terms of milk yield for bulls of five years and over, and to be of maximum value the bulls must be healthy and active for some time thereafter.

In herds of pedigree stock, it is not uncommon to find bulls kept for as many years as they retain their usefulness, but the dairy farmer with non-pedigree cows sees many difficulties in keeping a bull until he is five years' old. If the farmer is to avoid in-breeding, a second bull must be bought to serve the progeny of the first one, and few herds are large enough to warrant the keeping of two bulls; while old bulls occasionally develop bad tempers and become dangerous to handle, but this difficulty may largely be overcome by more careful housing, handling and regular exercise. Further, the possibility that, should the progeny test show the bull to be very deficient in power to transmit dairy qualities, the cost of two additional years' keep will be incurred without any return, makes farmers less willing to undertake the trial.

The most economical solution of this difficulty appears to lie in the co-operation of two or more neighbouring farmers. Two promising bulls might be purchased for two herds, on the understanding that during the first three years they should be used

approximately equally in both herds, and if one bull were found to be of great dairy prepotency, he would be kept as long as possible for mating with mature and unrelated cows. Under these conditions, however, judicious in-breeding most probably would give very satisfactory results. Such a scheme could be worked equally well with three participants. The same system could be followed without the risk of differences of opinion where one owner maintains a large herd or has cows at two or more homesteads. Young bulls would be required from time to time for mating with heifers, as is the custom at present.

The co-operative societies of small holders organised under the Ministry of Agriculture's Live Stock Improvement Scheme could adopt the tested sire system. Bulls could be transferred from one society to another, and the societies would have the advice and assistance of the Live Stock Officer at all stages. The period necessary for a progeny test could also probably be shortened by good management and feeding of the young stock, and by mating at an earlier age than usual.

Owners of pedigree herds who have confidence in the bulls they offer for sale might also come to some agreement with purchasers as to the retention of a bull for the necessary time, since, when a specially good bull is found, the family from which he is bred immediately increases in value.

Progeny Tests of Cows.—Tests of the power of transmission of dairy qualities in cows are not, of course, of the same importance as in the case of bulls. A cow will, on the average, have but five or six calves in a breeding herd, and as only half of these may be heifers, individual cows with the maximum power of transmission can, through their female progeny, make only a small contribution to the improvement of the herd. The basis of selection of cows for breeding must, nevertheless, be facts—not opinions—hence the need for a great development of milk recording to supply information on the degree to which dairy qualities are possessed by cows in the herd. The need for constitution must also be kept in mind; and, lastly, "foundation" cows should exemplify to a marked degree the type and characteristics of the breed.

Registers of Heavy-milking Cows and of Dairy Bulls.—Reference may also be made to the formation of registers of heavy-milking cows in relation to the breeding of dairy bulls. Registers of cows complying with certain conditions as to minimum yield, and other particulars, are now compiled by the Ministry of Agriculture, the Dairy Shorthorn Association, and at least one Breed Society, and one of the advantages claimed

for such registers is that they afford a basis for a register of bulls out of cows with authenticated yields. The emphasis already laid on the distinction between *possession* of dairy qualities and *power of transmission*, and on progeny tests, indicates another basis which might be adopted for entry into a register of bulls.

A register of bulls which have a minimum number of female progeny *qualifying for entry* into the registry of heavy milking cows will be a more valuable guide to breeders than a list of bulls out of registered cows. The entry of a bull into such a register would add greatly to its own value and to the value of its family, and the information would be an invaluable complement to pedigrees and of great assistance in selecting animals for any particular application of the line-breeding system.

Summary.—From the individual breeder's point of view, success in breeding for milk production is most likely to be attained by working steadily towards an attainable ideal embodying type, constitution, breeding powers and dairy qualities; by the selection of cows conforming as closely as possible to this ideal; by the study of pedigree and milk records; and by the use of bulls, good animals in themselves, and possessing some considerable degree of concentration of the blood of a family of cows (*i e*, line bred) showing the desired type and characteristics, and the required degree of dairy qualities. If an aged bull of the desired breeding and the sire of progeny of known merit can be obtained, a definite advance should be assured.

From the breed point of view, success lies in the direction of the identification and increase of families and animals possessing breed characteristics, dairy qualities, and the power of transmitting them to the utmost possible extent; the adoption of a uniform method of stating milk yields; the certification of milk yields and percentage of fat by an external authority; the development of registers for heavy-milking cows, with classes for different ages from the age at first calving to maturity, and the formation of registers of bulls with a minimum number of daughters entered in the heifer and cow registers.

From the national point of view, breeding for milk production would be assisted by the inauguration of a scheme for the collection of data on the possession and inheritance of dairy qualities and for the study of this data at the Institute for Research in Animal Breeding.

THE LIFE HISTORY OF THE COMMON MOLE

(*Talpa Europea*).

LIONEL E. ADAMS, B.A.

Most people have learnt that the mole is an insectivorous burrower with a cylindrical body covered with black velvety fur, which rises vertically from the skin. This peculiarity is alleged to have been acquired to enable the animal to move both backwards and forwards in its narrow tunnels without brushing the fur "the wrong way." Although it is true that the vertical fur can be smoothed in any direction, it is most unlikely that the peculiarity has been acquired for this purpose, since the animal can, with one or two strokes of his powerful fore-paws, clear enough space to turn round in a couple of seconds. In all probability the upright fur is useful for avoiding the retention of earth, and is easily scratched clean.

The mole's range, so far as the United Kingdom is concerned, embraces the whole of Great Britain, but not Ireland. It is found on the summits of our highest hills wherever worms exist, but is most plentiful in the low-lying plains. It may also be found burrowing on the sandy sea shores, even as far as the tide marks.

In order to follow the mole's career it will be convenient to start with an account of the courtship of the parents.

In early spring both sexes, especially the boars,* travel in search of mates. Their wanderings may often be recognised by small furrows, or tunnels so near the surface as to lift the soil in a ridge. These travelling runs are different from all other runs in that they are always in a straight line; they are usually called "rutting runs," although there is no evidence that pairing takes place within them. The meeting of the boars and sows is fortuitous and promiscuous, no pairs having been known to inhabit a nest together. The female prepares a special nest as a nursery on a somewhat similar but simpler plan than the winter fortress, which will be described later. So far as the writer is aware, no mammal prepares a nursery until well advanced in

* The sex names are "boar" and "sow."

pregnancy. If this holds good with regard to the mole, six weeks rather than one month is nearer the actual period of gestation, as some nests from which the writer has taken young had been made about a month previously.

The following evidence is sufficient to prove that the female *litters only once a year*.

Hundreds of dissections at all times of the year show that an enormous development of testes, prostate and corpus spongiosum, takes place in the male commencing late in January, and culminating about the end of March or the beginning of April, when pairing takes place. These organs afterwards decrease in size, until by the end of May they have become normal again. They remain in this condition during the rest of the year.

There is thus only one short "rutting" season, practically confined to the latter part of March, April, and perhaps occasionally the beginning of May, after which both sexes are completely exhausted. The earliest personal record the writer possesses for a foetal litter (which was within three or four days of birth) is 13th April, and the latest date he has seen young in the nest is on 25th June, these young moles were quite ready to leave the nest.

Thus, on the assumption that the period of gestation is four weeks (it is probably rather more) it is evident that the female would not have time to breed twice within the time mentioned during which young are found, even, as is not the case, if she were in condition to do so. Moreover, these limits of earliest and latest births are not those of the same year or locality, so they may be fairly curtailed, and a month of courtship may be presumed to be the limit of the mole's capacity.

The average number of young in a litter works out at rather more than 3.5. The writer's personal records are as follows:—

- 1 litter containing 1 young.
- 4 litters containing 2 young.
- 20 litters containing 3 young.
- 31 litters containing 4 young.
- 4 litters containing 5 young.
- 1 litter containing 6 young.

The writer selected one mole for measurement from each of several litters, and others from the same nests at intervals, and has prepared the following table of the rate of growth and concomitant personal appearance from the day of their birth to the twenty-second day, when they are ready to leave the nest. The measurements are in millimetres.

Number of Days old	Head & Body	Tail	Hind Foot	Colour	Remarks
1	42	8	5	Very red	Umbilical cord un- healed.
2	47	9	5.5	Red	Ditto.
3	52	10	6		
4	57	11	7		
5	62	12	8	Pink	
6	67	12	9		
7	71	13	9		
8	76	14	10		
9	80	15	11	Slightly lead coloured on back	
10	85	15	12	Slightly darker	
11	89	16	13		
12	94	16	14	Ditto	
13	99	17	15		
14	105	17	16	Lead colour all over, fin visible	
15	109	18	16		
16	112	21	16		
17	114	23	16	Completely covered with velvety lead- coloured fur	Ears open
18	115	23	17		
19	116	24	17		
20	117	25	17		
21	117	26	17	Fur nearly normal colour and length	Eyes showing a spot of matter; not yet open
22	118	27	17	Fur nearly normal	Eyes opening

During the summer and early autumn moles come to the surface in search of worms and to drink, the dewy herbage supplying the latter need. In the hot year of 1911 the surface of the ground in certain districts was caked so hard that the moles could not burrow through, and numbers of those which came above ground by their usual exits were unable to dig themselves in again, and so perished. One farmer stated that he used to go out at night with his dog, and killed over 300 on his own farm. In some parts of south Surrey the mole was almost exterminated.

The Mole's Fortress.—As autumn draws on, the impulse seizes the mole to prepare a winter habitation which is known as "the fortress."

Much legendary inaccuracy has been handed down about the mole and its fortress. It has been repeatedly asserted that the mole deliberately chooses the most suitable spot, preferably "in

the foundation of a wall, under a hedge, or at the root of a tree." In the vast majority of cases, however, the fortress is placed in the open field, and seldom in the situations indicated above, although very occasionally the writer has found fortresses near hedgebanks and under trees; in these instances the mole most probably was not aware of the tree. Abundance of food, nevertheless, does influence him in his choice, in so far as being satisfied with his locality, he encamps upon it. To imagine, however, that a practically blind animal of the mole's impatient disposition and subterranean habits can make a deliberate choice of the most favourable spot after a survey of the surroundings, is absurd.

Everyone is familiar with the time-honoured figure of the plan of the fortress. Originating from Geoffroy Saint-Hilaire and elaborated by Blasius, it has been copied by every succeeding writer without the slightest attempt at verification, until the publication of the works of J. G. Millais,* and the late Major Barrett-Hamilton.† The old text-books referred to this fortress as though all were constructed exactly alike on a pre-arranged plan of labyrinthine escapes from enemies above and below, whereas observation shows that the more or less complicated galleries are purely incidental in piling up a protecting heap over the excavated nest; there is one exception, however, which will presently be described.

The first act in the making of the fortress is the excavating of the nest cavity at some point in one of the usual tunnels. This cavity is spherical in shape and about the size of a man's head, and is just below the surface of the ground. The earth is ejected through a hole in the top in the same way as an ordinary molehill is thrown up, viz, by forcing the earth up with the top of the head in quick jerks.

As the ejected earth piles up, the mole must penetrate the heap and reach the surface, and in this way a tunnel is made. The nest cavity made, the next proceeding is to excavate the bolt run. This is a tunnel leading downwards from the bottom of the nest perpendicularly for some 6 inches, when it curves upwards and opens into the original tunnel leading into the nest cavity.

In order to protect the nest from enemies and weather, the mole proceeds to pile up a huge mound of earth on the top of the heap already over the nest, by further tunnelling outside the nest. In the process tunnels are formed within the mound,

* The Mammals of Great Britain and Ireland.

† A History of British Mammals.

the heaping up always being from below the surface. Dissections of hundreds of these fortresses plainly reveal the fact that they are not purposely made as escapes, but are purely incidental to the work for the protection of the nest. It is astonishing how well these tunnels keep their shape and do not fall in; probably their sides are tightly pressed by the working of the mole as he pushes the loose earth through them.

When complete the fortress is from 12 to 14 inches high and 3 to 4 feet in diameter. The nest cavity is filled with grass or leaves; in it the mole lives throughout the winter. The writer has known a large fortress erected in one night.

The nursery made by the female in spring is quite distinct. It is on the same plan as the fortress, but it very seldom has a bolt run, and is usually on a smaller scale.

When a mole erects a fortress on the same spot in the following year, he never uses the nest cavity previously made, but constructs a fresh nest in the mound close to the old one. The writer has found three such nests, each built on the top of the preceding one.

The Food of the Mole.—The mole is an insectivorous animal, but, like shrews, hedgehogs and others, it is also carnivorous. Examinations of stomachs made by the writer and others all tend to show that worms are the staple diet, but that any grubs, leather-jackets, and such like insects are eaten with equal readiness. The vegetable matter found in their stomachs is swallowed inadvertently in the hasty gulping down of their prey. The writer has watched his captives feed on worms. The mole, after seizing a worm with his mouth, would hold it down with his paws, and with his snout feel the way to one end (as often the head as the tail) where he would eat the worm, moving the while to the other end by a series of quick jerks. Sometimes he has brushed away the external earth from a worm with his snout and paws before commencing to devour it. On one occasion a large lobworm had burrowed nearly out of sight, when the mole found and seized it, but instead of tugging at the creature furiously and thereby breaking it and losing a portion, he held the worm taut and presently, yielding to a gentle strain, it was secured whole. This act shows that the moles acquire a remarkable experience of catching worms.

On another occasion, when a captive had been fed until he could eat no more, he seized a worm, bit it with quick bites along its whole length, and then crammed it into the earth,

left it, and turned about to find another. He was given another large lohworm, which he treated in exactly the same way, thrusting it into the same hole, which he immediately covered up by scraping the earth over it with his paws. On two other occasions the writer has seen a captive bury worms and also a dead mouse in this manner. The moles would eat dead mice, but preferred worms and slugs.

Moles have been accused by gamekeepers of eating the eggs of pheasants and partridges, but it is doubtful whether this accusation is altogether justified. It is possible that if an egg were to fall into the mole's tunnel as he was operating beneath the nest. He described the mass as "three spadefuls." This, but the writer has evidence of eggs being ignored by the mole.

There is an old story of moles storing worms, which appears to have some foundation. A farmer on whose land the writer was trapping moles told him that on digging out a fortress he came across a mass of worms in the nest cavity close beside the nest. He described the mass as "three spadefuls." This taken in conjunction with the writer's own observations of their burying habit, removed his previous scepticism on this point.

The mole does not hibernate, but wakes up in his warm nest in the fortress about every four hours, when he goes in search of food. His tracks have often been found in the snow.

Is the Mole blind?—Observations seem to point conclusively to the fact that the mole is practically blind.

When a worm is placed near a mole the latter immediately shows signs of excitement, being aware of its proximity by smell or hearing, but it is only after poking about with his snout that, haphazardly, he comes upon it. He never goes straight for a worm, and when a half-eaten worm is dropped and has crawled away a little, the same hunt for it is repeated.

The test of waving a lighted candle before captive moles has been tried, and it was found that the animals took no notice of the light. Moles met with casually in a country lane also have never endeavoured to get out of the way so long as they were not actually touched.

It is remarkable how soon captives become tame, or rather, indifferent to being handled. When first caught they squeak and bite viciously, but half an hour afterwards they have allowed themselves to be taken up by the skin of the back without any resistance. The writer has frequently stroked and tickled his captives while they were engaged in eating, and has held them up by the tail while they lapped water. He

taught one captive to come for food at the sound of scratching the earth or the side of its box.

Enemies of the Mole.—The mole's natural enemies in Great Britain are few and incidental. Our native snakes are not able to tackle so large a prey successfully, although adders have been said to swallow them.

The weasel has often been caught in mole traps set in the runs, and doubtless the larger stoat preys upon moles occasionally, but it is not likely that the stoat can follow the mole along the runs.

The heron probably snaps one up by the waterside now and then, as this bird has been known to swallow a nearly full-grown water vole.

The writer has often found moles' skulls and bones in owls' pellets. He once possessed a fox terrier which would hunt moles successfully, scratching one out of a molehill beneath which it was working, but the dog would never treat the moles seriously as he would rats, and he never troubled to shake or kill them.

Mole-catchers have asserted that foxes dig out and eat the young, and that badgers will dig up traps and eat the dead moles out of them.

It does not seem that rooks prey on moles, although crows may do so, and the larger hawks may account for a few.

Man, of course, is the mole's greatest enemy, especially now that the skins have a commercial value.

Whether the mole is harmful or beneficial to agriculture of course depends entirely upon local conditions. On heavy soil the tunnels are useful as drains, and the earth turned up serves as top dressing when spread by bush-harrowing; but on pasture land, if mole heaps are too numerous, a large percentage of surface is lost. In mowing grass the heaps are a great nuisance, as they clog the machine cutters. The mole's surface burrowing is also injurious to all crops when in the seedling stage. The animals consume many of the farmer's enemies, and never vegetable matter, except a very trifling amount swallowed inadvertently.

ACCESSORY FOOD FACTORS, OR VITAMINES.

THE reference in the June issue of this *Journal* to Sir Daniel Hall's Third Chadwick Lecture, in which a short account of "vitamines," or accessory food factors, was given, has led to a request for the publication of further information on the subject. A full account of the present state of knowledge concerning accessory food factors, by the National Health Insurance Medical Research Committee, was published in 1919, and the account here given is a summary of that report.*

Accessory food factors—so called because the foods in which they are present contain them only in minute amounts—play a prominent part in nutrition, since, if these minute amounts are removed from natural foods, such foods fail to maintain healthy nutrition, and grave symptoms of actual disease may supervene. Among the diseases which have definitely been shown to be produced by the absence of these factors are scurvy, rickets and beri-beri. Research suggests that the nature of vitamins is quite distinct from that of proteins or of foods which supply energy, but at present we have no knowledge concerning their actual chemical nature. It is thought that they may either (a) be structural components of living tissues of which a supply is essential, though quantitatively unimportant, or (b) that they may act rather as catalysts in certain normal processes of metabolism. There is evidence to suggest that these accessory food factors are formed only in the tissues of plants, whence they pass into the tissues of herbivorous animals and thus become available for carnivora.

Vitamins are always present in natural foodstuffs as instinctively consumed by men and animals; broadly speaking, it is safe to say that the individual always finds a sufficient supply of vitamins in his food, so long as that food is reasonably varied and has received no artificial or accidental separation into parts, and so long as no destructive influence has been applied to it.

Clear evidence has been obtained of the existence of three accessory food factors:—

(1) *Fat Soluble A Factor*.—This term was given to this factor by American investigators, as it is soluble in fats and accompanies them in the process of isolation from certain food-

* *Special Report Series No. 38, H.M. Stationery Office, 1919, 4s. net.*

stuffs; this factor is probably identical with that, the absence of which leads to rickets in young. This factor is in all probability synthesized by the plant, and its primary sources are found in the green leaves of plants and the embryos of certain seeds. Beyond these primary sources the main sources are certain fats of animal origin, such as butter. The distribution of this factor in foods will be found in the Table concluding this account.

This factor is gradually destroyed at 100° C. (the boiling point of water), and four hours' exposure to that temperature is sufficient to render butter-fat of little greater nutritive value from the standpoint of vitamine supply than an equivalent quantity of lard. The factor is also destroyed during the hardening of oil by the action of hydrogen, a process now widely employed for the preparation of edible fats such as margarine.

We as yet know nothing definite of the part this factor plays in the nutrition of the body. Storage of the factor appears to be particularly marked in adult animals, and the requirements after maturity is reached are of a smaller order than those of the growing young. Such storage is of considerable importance to the pregnant and nursing mother, for she can provide her young with a high concentration of this factor without immediate dependence upon an external supply.

(2) *Water Soluble B Factor*.—This term is also that of American investigators, this factor being soluble in water; and it is probably identical with the anti beri-beri and anti-neuritic factor. The primary sources of this factor also are provided by the plant kingdom. It is widely distributed, having been found in all the natural foodstuffs examined, and it apparently exists free in the plant cell. The principal sources have proved to be the seeds of plants and eggs of birds. In cereals the largest deposit is found in the embryo or germ, the bran coming next, while the endosperm is deficient. This fact accounts for outbreaks of the disease beri-beri among peoples existing on a diet of polished rice.

The requirements of the body for this factor are much greater during growth than maturity, and the large deposits in seeds and eggs suggest a due provision made for the wants of the young offspring during the early period of life. It does not seem that the normal animal possesses any large reserve of the water-soluble factor in an available form, and while (as in the case of the fat soluble factor) the quality of the milk of the

nursing mother will suffer if her diet becomes deficient in this essential, the adverse effects here are much more rapid owing to the smallness or absence of such reserve supply.

The factor withstands desiccation for long periods of time. Its resistance to heat is also considerable; destruction takes place very slowly at 100° C. (212° F.), but is much more rapid in the neighbourhood of 120° C. (248° F.). Tinned foods of all descriptions, with but few exceptions, would therefore be deficient in this vitamine.

The distribution of this factor in foods is given in the concluding Table.

(8) *Anti-Scorbutic Factor*.—The preceding factors are admittedly indispensable for growth as well as nutrition. The third or anti-scorbutic factor is undoubtedly indispensable for normal nutrition of certain species of animals, but in the light of present knowledge it is difficult to say whether it is indispensable as a component of a normal dietary for growth, because wide variations occur in the requirements of various species for this substance.

This vitamine is necessary in a diet for the prevention of scurvy, and is found in fresh vegetable tissues and (to a much less extent) in fresh animal tissues. Its richest sources are such vegetables as cabbage, swedes, turnips, lettuce, watercress, and such fruits as lemons, oranges, raspberries and tomatoes. Inferior in value are potatoes, carrots, French beans, scarlet runners, beetroot, mangolds, and also (contrary to popular belief) lime juice. Potatoes, although classed among the less valuable vegetables as regards anti-scorbutic value, are probably responsible for the prevention of scurvy in Northern countries during the winter, owing to the large quantities which are regularly consumed. Milk and meat possess a definite but low anti-scorbutic value.

This vitamine suffers destruction when the fresh foods containing it are subjected to heat, drying, or other methods of preservation.

All dry foods are deficient in anti-scorbutic properties; such are cereals, pulses, dried vegetables and dried milk.

Tinned vegetables and tinned meat are also deficient in the anti-scorbutic principle. In the case of tinned fruits the acidity of the fruit increases the stability of the vitamine, and prevents to some extent the destruction which would otherwise occur during the sterilization by heat and the subsequent storage.

Distribution of Vitamines in Foodstuffs.—The table here given shows the distribution of vitamins in the chief foods. The relative values of the foodstuffs are indicated by positive and negative signs. With increased relative value more than one positive sign is employed; a zero indicates the absence of the factor. Absence of a sign does not, however, indicate the absence of the factor.

<i>Classes of Foodstuff.</i>	<i>Fat-soluble A Factor.</i>	<i>Water-soluble Boro- anti-neuritic (anti- beri-beri) Factor.</i>	<i>Anti-scorbutic Factor.</i>
<i>Fats and Oils.</i>			
Butter	+ + +	0	
Cream	+ +	0	
Cod-liver oil	+ + +	0	
Olive oil	0		
Coconut oil	0		
Linseed oil	0		
Fish oil, whale oil, herring oil, &c.	+ +		
<i>Meat, Fish, &c.</i>			
Lean meat (beef, mutton, &c.)	+	+	+
Fish, white... ..	0	very slight, if any	
„ fat (salmon, herring, &c.)	+ +	„	
<i>Milk, Cheese, &c.</i>			
Milk, cow's whole, raw	+ +	+	+
„ skim	0	+	+
„ dried whole	less than + +	+	less than +
„ condensed, sweetened	+	+	„
Cheese, whole milk	+		
„ skim	0		
<i>Eggs</i>			
Fresh	+ +	+ + +	0
Dried	+ +	+ + +	0
<i>Cereals, Pulses, &c.</i>			
Wheat, maize, rice, whole grain	+	+	0
„ „ „ germ	+ +	+ + +	0
„ „ „ bran	0	+ +	0
Linseed, millet	+ +	+ +	0
Dried peas, lentils, &c.		+ +	0
Soy beans, haricot beans	+	+ +	0
Germinated pulses or cereals ..	+	+ +	+ +
<i>Vegetables and Fruits.</i>			
Cabbage, fresh raw	+ +	+	+ + +
Swede, raw expressed juice ..			+ + +
Carrots, fresh raw	+	+	+
Potatoes, raw	+	+	
Apples			+
<i>Miscellaneous.</i>			
Yeast, dried	?	+ + +	

The facts discovered so far are principally concerned with the causes producing diseases in animals, but there can be no question that further investigations will disclose that vitamins may play a part in the production of animal products (such as meat and milk) for economic purposes generally.

"DAMPING OFF" OF TOMATO SEEDLINGS.*

W. F. BEWLEY,

*Mycologist at the Experimental and Research Station,
Cheshunt, Herts.*

THE disease of tomatoes known as "Damping off" is of common occurrence in nurseries in this country during the propagating season. At times it causes considerable damage, giving rise to serious financial losses. Cases are known where nurserymen have lost as many as 50,000 young plants in a season owing to this disease, and most growers have experienced anxiety as to it at some time or another.

Description.—The symptoms of the disease are readily recognised. The seedlings are attacked at the soil level or a little above it; the organism readily pierces the external skin, and destroys the internal tissues. The latter collapse, assume a brown colour at the point of attack, and the seedling falls over. The action of the parasite is very rapid, 18 hours only being sufficient to cause death. Often the plant is attacked at a later period in its life, when it has been "pricked out" into pots or even planted in the houses; the symptoms are practically the same as in the seedling stage. This later appearance of the disease is often termed "Blackleg" or "Foot rot" by growers. The disease is usually caused by pathogenic organisms, but some discrimination is necessary, because the presence of injurious chemical factors in the soil may produce similar symptoms. Among the latter factors may be mentioned free ammonia and certain acids such as cresylic acid. The investigations here discussed deal only with the diseases caused by pathogenic fungi.

Three different organisms have been found to produce "Damping off" of tomato seedlings in the Lea Valley, viz., *Phytophthora parasitica* (Dastur), *Phytophthora cryptogea* (Pethybridge) and *Rhizoctonia solani* (Kuhn). The disease organisms exist in certain soils as a definite infection, but are absent in others. The infection may be carried from one season to the next in the seedboxes and pots. Another frequent source of infection is the water supply. Examination of a large number of nursery waters showed that the above mentioned fungi were

* An abridged account of an investigation to be published in full in the *Annals of Applied Biology*, Vol. VII., No. 2, 1920.

present in several instances. Further work is being done in this direction, but in the meantime the importance of a pure water supply cannot be too strongly emphasised.

All precautions should be taken to avoid the wells being polluted by surface drainage from the nursery or any adjoining allotment or garden.

Many samples of seed have been examined, but in no case up to the present have the "Damping off" organisms been found on the seed.

Experimental Tests.—Different methods of making seed beds, sowing seeds, watering, &c., have been investigated to ascertain the relation of these operations to the incidence of the disease. A covering of sand, charcoal or lime either alone or above a covering of sterile soil produced only a small increase or decrease in the amount of disease. Charcoal had no effect when used alone as a covering to the seeds, while sand reduced the amount of diseased seedlings by 20 per cent. Five per cent. of charcoal mixed with the soil had a distinctly beneficial result; in addition to reducing the amount of disease, a fine crop of sturdy dark green seedlings was produced. In the case of lime, it was found that whether mixed with the soil or added as a covering to the seeds, this constituent apparently caused an increase in the amount of disease.

Sowings of seeds closer than 50 per box (14 in. by 9 in. by 2 in.) should be avoided, as the practice materially assists the spread of the disease.

Watering in the morning or evening is preferable to performing this operation at midday, while bottom watering, by standing the boxes in a shallow tray containing water half an inch deep for five minutes, is preferable to top watering. Dressings of nitrate of soda or superphosphate were found to have little effect upon the amount of disease, but half an ounce of sulphate of potash added to 5 lb. of soil resulted in a considerable reduction of the pest.

Many fungicides were tried, but only one gave any success, viz., a mixture of 10 parts of lime and 1 part of copper sulphate. Dry powdered lime, obtained by slaking caustic lime, and ground copper sulphate, were thoroughly mixed and spread over the surface of the soil at the rate of $\frac{3}{4}$ oz. per square foot, and disease on plants grown on this soil was reduced from 47 per cent. to 7 per cent.

A relatively high percentage of moisture in the soil and the air favours the rapid spread of the disease. Careful regulation

of the watering, so as to keep the seed boxes uniformly moist, and good ventilation of the propagating houses to dry out the surface soil, will produce the best moisture conditions for checking the disease. The optimum temperature for growth of *P. parasitica* is about 30° C. (86° F.), and that of *P. cryptogea* and *Rhizoctonia* about 25° C. (77° F.). Below 12° C. (54° F.) the growth of all three is very slow. If the disease starts, the grower should endeavour to keep the temperature down as far as possible, without impairing the health of his plants.

Sterilisation of the soil by heat or formaldehyde has proved the most effective method of controlling "Damping off." All strengths of formaldehyde solutions from two per cent. upwards are effective for soil sterilisation, but weaker solutions are not sufficiently strong to sterilise the soil completely. The method employed for sterilisation by formaldehyde is as follows:—

A two per cent. formaldehyde solution is made by adding one gal. of commercial formaldehyde (40 per cent. formaldehyde) to 50 gal. of water. Pots and boxes are sterilised by soaking them in the formaldehyde solution for ten minutes and then placing them in a heap and covering with sacking for 48 hours in order to allow the vapours of the formaldehyde to act. After this period the sacking is removed and the boxes are allowed to dry. They may be used as soon as the smell of formaldehyde has vanished. The soil may be sterilised, either in the boxes or in a heap. In the first case the boxes are filled with soil and the formaldehyde solution is poured on until the former is saturated. About a pint of solution is necessary for 5 lb. of soil of average wetness. The boxes are then covered with glass for 48 hours to keep in the vapours. At the end of this period the covers are removed and the soil is allowed to dry. When the formaldehyde vapours have evaporated, usually a week or ten days after removing the covers, it is safe to sow. Soil may be sterilised in a heap by saturating it with the formaldehyde solution, covering with sacking for 48 hours, and allowing it to dry before using.

Summary of Methods of Control.—The following points should be observed:—

1. A pure water supply should be used.
2. All seed boxes, pots, and propagating soil should be sterilised by heat or formaldehyde.

3. If "foot rot" has been prevalent in the houses during the last season the soil should be steamed.

4. The watering should be carefully regulated, and waterlogged conditions or a saturated atmosphere in the propagating houses never allowed.

5. The propagating houses should be thoroughly ventilated, and a uniform temperature of about 55°F. maintained, if the disease appears.

6. Any diseased seedlings should be picked out and destroyed by burning as they appear.

7. A top dressing of 10 parts lime and 1 part copper sulphate applied to the soil at the rate of $\frac{3}{4}$ oz. of the mixture per square foot will help to reduce the amount of disease.

PERENNIAL RYEGRASS AND WILD WHITE CLOVER.

PROFESSOR GILCHRIST of Armstrong College, Newcastle-on-Tyne, who has arranged to deliver a series of lectures in the North of England in connection with the Ministry's grassland campaign, addressed a meeting of farmers at Thirsk on 16th August, at which he laid great emphasis on three important points in grassland improvement:—

- (1) The benefits following the inclusion of wild white clover in seed mixtures.
- (2) The value of perennial ryegrass, and the proper method of retaining and developing this grass.
- (3) The improvement of turf which results from proper treatment of grass.

Wild White Clover.—At Cockle Park, as the outcome of many years' experience, $1\frac{1}{2}$ lb. of wild white clover seed per acre are now usually included in the seeds mixture for a ley of three years or longer duration. A fair proportion of wild white clover plants in the aftermaths of one-year leys has been produced with $\frac{1}{2}$ lb. or even $\frac{1}{4}$ lb. of seed, but the first year's aftermath in three-year leys, for which $1\frac{1}{2}$ lb. of wild white clover seed has been included in the mixture, is much more satisfactory, a good covering of clover being quickly obtained, effectually checking the development of weedy herbage which is otherwise rapid. The seeds mixture for three-year leys on this poor clay is as follows:—16 lb. perennial ryegrass, 10 lb. cocksfoot, 4 lb. Timothy, 4 lb. late flowering red clover, 1 lb. trefoil and $1\frac{1}{2}$ lb. wild white clover. The rotation is a six-course one, and since 1912 there have been five 3-year leys from which the average weights of hay in the first, second and third years have been 42 cwt., 45 cwt., and 38 cwt., per acre respectively. Such excellent results in the second and third years are undoubtedly due to the inclusion of wild white clover. The clover aftermaths have been of a most valuable character for grazing, and as good in the second and third years as in the first, while the turf at the end of the three years is always excellent.

The effect of including wild white clover in the seeds mixture was further tested on Tower Hill Field in 1907-1917 on poor stiff clay soil of low value. An addition of 4 lb. wild white clover seed per acre to the mixture increased the hay crop by 6 cwt.

per acre for each of the first three years, by 20 cwt. annually for the next three years, and by 8 cwt. annually for the last five years. The benefit was thus greater in the later years than in the earlier, and the average crop of hay per acre for the eleven years was 34 cwt. with wild white clover and 23½ cwt. without. Wild white clover increased the hay crops not only by its own herbage but also because the nitrogen collected by its roots stimulated the grasses growing with it. Better grasses are now growing on the wild white clover plot; there are fewer weedy grasses and less weedy herbage; the hay throughout has been superior in quality, and the aftermaths have been much more valuable.

Treatment of the Ley.—A good seed bed is of the greatest importance, especially when land laid down from recently ploughed out old turf is sown away. Such old turf specially requires good harrowing to get a tilth, and rolling well to get a firm seed bed. The best seed bed will be obtained when seeds are sown with a cereal crop like barley, in spring. If the land is heavy, ploughing should be completed in early winter, so that the frost may pulverise the surface. At Cockle Park the experience is that grass and clover seeds are likely to do best when sown immediately after a spring-sown corn crop.

In the case of the three-year leys instanced by Professor Gilchrist, 10 cwt. per acre of basic slag (39 per cent. phosphates) was applied to the young seeds as soon as possible after the barley crop was harvested. This was the only manure used throughout each period of three years. On Tower Hill Field 10 cwt. per acre of basic slag (39 per cent. phosphates) has been applied every third year.

Late Flowering Red Clover.—It will be observed that the mixture used for the three-year leys includes late flowering red clover as well as wild white clover. This is due to the fact that clover sickness gives much trouble at Cockle Park, and late flowering red clover gives better results than ordinary red clover.

Perennial Ryegrass.—In the past, the usual experience of farmers has been that perennial ryegrass remains a good plant only for a few years, and, under ordinary conditions, weedy herbage then takes its place. Professor Gilchrist explained this failure as being due largely to the absence of close grazing and heavy treading by stock. Probably no grasses stand close grazing and heavy treading better than do perennial ryegrass.

and crested dogstail; it is under such conditions that they are encouraged. The more a pasture is trodden down, and, up to a certain point, the more closely it is grazed, the more nutritious will be the pasture and the more numerous the head of grazing stock which it will carry. Several instances were cited by Professor Gilchrist, viz.:—

- (1) In Tree Field and Hanging Leaves Fields at Cockle Park, which originally contained bents, wiry fescues and carnation grass, perennial ryegrass is now in many cases the dominant grass where the pastures are effectually improved and most closely trodden and grazed.
- (2) Examinations of the old turf on Newcastle Town Moor and many other old turf pastures show that where the herbage is closely grazed and most nutritious, perennial ryegrass and crested dogstail are largely developed.
- (3) Sir Henry Gilbert noticed at Rothamsted that perennial ryegrass was found abundantly in old pastures that were regularly grazed, but only sparingly where the old ley was regularly mown for hay. He stated his conviction that close grazing did much to develop perennial ryegrass.
- (4) In a large field in Northumberland, which was sown down seven years ago, it was found that where wild white clover was sown with perennial ryegrass only, and slagged, closely grazed and heavily trodden, a pasture of high feeding value was developed. If no wild white clover had been sown, and if the field had not been slagged, it is probable that there would have been no plants of perennial ryegrass and that the pasture would have been worthless and full of weeds.

It is very desirable that stocks of perennial ryegrass should be obtained from old leys, as they will probably prove of much greater value for purposes of permanent pasture. Peacey's perennial ryegrass was selected from meadows in the Cotswold valleys at the end of the 18th century. It was claimed for this that it had "early growth, larger crops, grateful flavour, nutritious food and permanence."

Improvement of Turf.—To illustrate the improvement of turf which follows the treatment outlined above, viz., presence of wild white clover and perennial ryegrass, application of basic slag, and close grazing, Professor Gilchrist exhibited

contrasting specimens of turf from Cockle Park. Two, of wild white clover and perennial ryegrass, were from poor clay loam soil from Palace Leas Field (meadow hay). Where sulphate of ammonia had been regularly applied, the specimen showed an accumulation of dead organic matter, about 3 inches deep, on the surface, effectually preventing rain from penetrating it and resulting in a dry condition of the soil beneath. Where basic slag had been used the specimen showed no dead organic matter, but a sweet and nutritious grass and clover herbage, and the turf was greatly enriched by an abundance of clover root, which rain could penetrate. The amount of nitrogen in the surface of 6 inches of soil is greater by about 400 lb. per acre (the equivalent of 22 cwt. nitrate of soda) in the basic slag turf than in the sulphate of ammonia turf. A similar contrast was exhibited by turves from light sandy soil in Davy Houses Field, which is very old pasture. Unmanured turf consisted mainly of poor, wiry bent and fescue grasses, with stunted and starved wild white clover plants, and nearly two inches of dead organic matter below the turf, underneath which was dry and apparently worthless soil. Turf treated with basic slag and closely grazed with cattle contained practically no dead organic matter nor wiry bent and fescue grasses, but an abundance of perennial ryegrass and other good grasses, in addition to a luxuriant growth of wild white clover; the soil underneath appeared a good sandy loam, dark in colour, with rich organic matter and moisture. Another specimen of turf was from a strong, clay loam on Davy Houses Field. No perennial ryegrass or wild white clover had been sown for 25 years, but basic slag treatment was commenced in 1903, and close grazing has been practised. The turf is a valuable grazing herbage, possibly as nutritive as can be obtained, and consisting almost entirely of perennial ryegrass and wild white clover.

COMMERCIAL MUSHROOM CULTIVATION.

HITHERTO the cultivation of mushrooms has been considered highly speculative, but recent experience and the knowledge gained by research now make it possible to grow fair crops with a greater element of certainty. Even the most experienced growers, however, are liable to failure, and the beginner should not be tempted by a small initial success to embark on mushroom growing on a large scale. Nevertheless, mushroom growing within small limits may be made a useful adjunct to a nursery or market garden, and even if failure should result, the manure used may still be turned to account for other crops, so that the only loss is that of the cost of labour and spawn.

There are three stages in the life of a mushroom: (1) spores, (2) mycelium or spawn, (3) mushroom. The spores may be seen with the microscope on the under side of the fully developed mushroom. These, when matured, fall off and are carried away by the wind. Under suitable conditions the spores develop into spawn in some favourable medium such as stable manure. In making ordinary commercial spawn, cakes measuring 9 in. by 6 in. by 4 in. are pressed from a wet mixture of horse manure, cow dung and loam, and in each of these cakes several small pieces of virgin spawn are embedded. The cakes so prepared are then stacked in a shed and covered with hot dung, producing a temperature and atmosphere suitable for the growth of the mycelium. When the spawn has spread through the whole of the cake, the pieces are loosely stacked and dried ready for sale or use. The final stage of development occurs in the bed where the mycelium, having spread through the dung, forces its way through the covering of soil, and forms small groups of nodules, some of which develop into mushrooms. Normally the production of mushrooms continues until the supply of nitrogenous matter contained in the dung runs short.

Intending growers will be well advised to buy spawn ready made from a manufacturer of good repute. Spawn is sold by the bushel of 16 cakes, one bushel being required for every 2½ tons of dung. It should be bought dry, and a cake, when broken into pieces, should show the white threads of mycelium throughout the whole cake. Full instructions for the preparation of manure intended for mushroom beds will be found in the Ministry's Leaflet No. 276, copies of which may

be obtained on application, free of charge, to the General Secretary, 8, St. James's Square, London, S.W.1. The leaflet describes also the methods of indoor and outdoor culture.

For indoor culture any place that provides an agreeable temperature and is free of draughts, can be used. Cellars, barns, stables, wooden sheds, disused tunnels, quarries, vineries and cucumber houses can all be successfully adapted for mushroom cultivation. The roof and sides of wooden sheds should be covered with a thick thatch of straw, and provision made for ventilation in the roof. It is also an advantage to instal hot-water pipes. If vineries are used the flat beds should be on the pathway, with at least 3 ft. of the vine border left clear. The same rule applies to cucumber houses. In each case a raised plank should be provided, so that the crop may be picked without the operator setting foot on the bed. Ridge beds may be made in very wide greenhouses. Except in glasshouses, indoor beds may be made at any time of the year; the beginner should, however, avoid commencing his preparations during the months of May, June and July.

For outdoor cultivation of mushrooms the selection of a site is a matter of importance, especially if the crop under cultivation is to be on a large scale. Among the essentials are natural shelter from cold winds and a good supply of loam or sandy loam for the casing of the beds; adequate drainage is also necessary. Shelter from cold winds may be increased by the use of high wind breaks made of straw or straw mats, and it is of advantage to have an ample supply of straw within easy distance. September, October, December and January are the usual months for making up outdoor beds. The September and October beds should start to bear in December and continue until March, and the second will commence in March and finish in June. It is well not to attempt summer cultivation until the grower has attained considerable experience. The leaflet mentioned gives detailed instructions for the construction of flat and ridge beds, the preparation of which is a rather elaborate operation. The question of temperature is also very important, and in this there is a considerable difference of opinion. When the beds are properly made up, the manure develops a temperature rising from 80° F. to about 140° F. This temperature then falls, and when it has dropped to 85° F. in flat beds and 80° F. in ridge beds, the time has come for spawning to begin. If the temperature is allowed to drop to 75° F. it is possible that the spawn will either not develop at all or only develop very slowly. Mushrooms

should begin to appear in from 6 to 8 weeks, but even if this time is exceeded, hope need not be given up, as a little extra covering or additional heat may still bring the crop along. Beds that have lain dormant for more than three months have, in the end, been known to yield a heavy crop. In normal circumstances, the bed will need to be picked over three times a week, but the frequency of picking is regulated by the progress of the crop.

In picking mushrooms for market, the contents of each basket should be made up to even weights, usually 5 or 6 lb., good weight being allowed to compensate for evaporation in transit. Packing with the stems upwards prevents the spores falling on the mushrooms below and spoiling the colour. For the sake of appearance, however, the top layer may be packed with the stems downwards. Baskets should be marked "Perishable, Mushrooms, With Care," and should be covered with tough brown paper and tied down with strong twine. The marketing of mushrooms is helped by grading, a comparatively simple affair. The chief recognised grades of mushrooms are (1) buttons, (2) cups, (3) broilers, (4) roughs. Buttons are the mushrooms which have not opened. Cups are partly open, broilers are fully opened, and roughs are broken and imperfect specimens rejected from the other grades. An experienced grower can obtain an average crop of 40 lb. to one ton of manure used. Since the War, the increase in the price of materials has made it impossible to raise a crop of mushrooms for less than 30s. to 40s. per ton of manure employed. The increase in prices, however, has kept pace with the costs of production, and the rates obtaining during 1919 at Covent Garden showed that cultivation might still be carried on on economic lines, although no hard and fast rules can be laid down as to the prices likely to obtain in the future.

FEEDING STUFFS IN OCTOBER.

PROFESSOR T. B. WOOD, C.B.E., M.A., F.R.S.,

Animal Nutrition Institute, Cambridge University.

SINCE last month, cereal feeding stuffs are slightly cheaper, but oil seed cakes on the other hand are slightly dearer. The cheapest cereals are maize and coarse middlings, which now cost only a fraction over 2d. per pound of starch equivalent. Palm kernel cake has gone up steadily in price since the early summer, when it was only £8 per ton. It is still, however, the cheapest concentrated feeding stuff on the market, costing even at its present price of £12 10s. per ton slightly under 1½d. per pound of starch equivalent.

During the month several correspondents have inquired as to the digestibility of certain feeding stuffs for young animals. The digestibility figures on which the starch equivalents given in the Table are based have been determined in all cases by experiments on adult animals. There is no definite knowledge available as to the digestibility of feeding stuffs for young animals. In the present state of our knowledge the only safe way of feeding young animals is to include in their diet only those feeding stuffs which experience has shown to give good results. These foods will no doubt vary considerably in the cost per pound of starch equivalent; the Table will show which of them are cheaper.

The description of the manufacture of fish meal given in last month's Notes was not quite clear in all details. For making fish meal for feeding purposes, only white fish is used. This kind of fish contains only a small proportion of oil, and extraction of the oil is therefore not necessary.

The discrepancies between the results obtained by various experimenters with palm kernel meal have given rise to many inquiries. So far as the writer can determine, the discrepancies are due to the fact that two kinds of palm kernel meal are on the market. Palm kernel cake meal, that is to say, palm kernel cake (made by *pressing* out the oil) which has been finely ground to meal, has always given good results. Palm kernel meal made by grinding the raw material and extracting the oil chemically is a much less satisfactory feeding stuff. It contains only about 1 per cent. of oil, whereas the ground cake contains 6 per cent. Buyers should see that they get *palm kernel cake* meal.

NAME.	Price per Qr		Price per Ton.	Manurial Value per Ton.	Food Value per Ton.	Starch Equiv. per 100 lb	Price per Unit Starch Equiv	Price per lb. Starch Equiv.
	s	lb.	£ s.	£ s.	£ s.	s.	d.	
Barley, English Feeding	80/-	400	22 6	1 6	21 0	71	5/11	3.16
" Foreign - -	75/-	400	21 0	1 6	19 14	71	5/7	3.09
Oats, English - -	60/-	336	20 0	1 9	18 11	59.5	6/3	3.35
" Foreign - -	57/-	320	20 0	1 9	18 11	59 5	6/3	3.35
Maize - -	75/-	480	17 10	1 5	16 5	81	4/-	2.15
Beans, English spring	120/-	532	25 0	3 1	21 19	66	6/8	3.56
" " winter	108/-	504	24 0	3 1	20 19	66	6/5	3.43
" Chinese - -	20/-	112	20 0	3 1	16 19	66	5/2	2.77
Peas, English blue	110/-	504	24 10	2 13	21 17	69	6/4	3.50
" " dun	100/-	504	22 5	2 13	19 12	69	5/8	3.04
" " maple	115/-	504	25 10	2 13	22 17	69	6/7	3.44
" Japanese - -	140/-	504	31 10	2 13	28 17	69	8/4	4.75
Buckwheat - -	—	—	—	—	—	—	—	—
Rye, English - -	80/-	480	18 10	1 8	17 2	72	4/9	2.55
Millers' offals—Bran	—	—	14 10	2 10	12 0	45	5/4	2.86
" " Coarse " " middlings	—	—	15 10	2 10	13 0	64	4/1	2.18
Barley meal - -	—	—	24 0	1 6	22 14	71	6/11	3.72
Maize " - -	—	—	19 0	1 5	17 15	81	4/5	2.37
Bean " - -	—	—	22 10	3 1	19 9	66	5/11	3.16
Fish " - -	—	—	25 10	7 12	17 18	53	6/9	3.62
Cakes, Linseed - -	—	—	23 10	3 12	19 18	74	5/5	2.90
" Soya - -	—	—	—	—	—	—	—	—
" Cotton seed - -	—	—	14 0	3 5	10 15	42	5/2	2.77
Cotton seed decorticated	—	—	21 10	5 6	16 4	71	4/7	2.47
" decorticated meal	—	—	21 10	5 6	16 4	71	4/7	2.47
Coconut - -	—	—	14 10	3 0	11 10	79	2/11	1.56
Groundnut - -	—	—	16 5	3 9	12 16	57	4/8	2.50
" decorticated - -	—	—	20 0	5 5	14 15	73	4/1	2.19
Palm kernel - -	—	—	12 10	2 1	10 9	75	2/9	1.47
" " meal - -	—	—	12 15	2 1	10 14	75	2/10	1.51
Brewers' grains, dry	—	—	12 0	2 7	9 13	49	3/11	2.09
" " wet - -	—	—	0 18	0 12	0 6	15	0/5	0.22
Distillers' " dry	—	—	14 0	2 16	11 4	57	3/11	2.09
" " wet - -	—	—	1 0	0 13	0 7	16	0/5	0.22
Malt culms - -	—	—	10 0	3 6	6 14	43	3/2	1.70

MANURES IN OCTOBER.

E. J. RUSSELL, D.Sc., F.R.S.,

Rothamsted Experimental Station, Harpenden.

THE opening of the season 1920-21 finds the farmer still faced with some of the old war-time problems; the need for increased production is as insistent as ever: more corn is needed; not less, and if possible more, land is wanted under the plough. Agriculture is rapidly advancing in importance in the national economy. Fortunately, the labour supply in many districts is sufficient to allow an energetic programme to be carried out, and there is a good, though perhaps not an over large, supply of fertilisers.

Storing Artificials.—Farmers who can store fertilisers will do well to lay up stocks for the season and to obtain their autumn and spring dressings as early as convenient. Three classes of fertiliser will be needed:—

For the grass land.—Basic slag; a trial may also be made with ground mineral phosphates.

For the corn.—Nitrate of soda and sulphate of ammonia; a trial if desired with nitrate of lime or with nitrolim.

For green crops fed to animals, for mangolds, swedes, &c.—Superphosphate.

For potatoes, mangolds, and on light soils for clover and oats.—Potassic fertilisers, in addition to phosphates and nitrogenous fertilisers.

Quantities required.—There is no doubt that high farming is the best and soundest line to adopt, and that a liberal use of fertilisers is advantageous both to the individual and to the community. The following quantities may be used:—

Basic slag.—Up to 7 or 8 cwt. per acre of present-day grades for grass land which has not been slagged for the past four years.

Nitrogenous fertilisers, nitrate of soda or sulphate of ammonia.—About 1 cwt. per acre for second straw crops, and for all other corn crops except those grown after roots fed off with fairly good supplies of meal or cake. *Nitrate of soda* up to 2 cwt. for mangolds, cabbage.

Sulphate of ammonia up to 2½ cwt. for potatoes.

Superphosphate.—About 2 cwt. per acre for corn that is likely to want help; from 3 up to 5 or 6 cwt. for root crops grown for sheep or cattle, and for potatoes. Less will be required where farmyard manure has been used.

Potassic fertilisers.—2 cwt. per acre of sulphate or muriate of potash for mangolds, potatoes, and on light soil or chalk soil for corn or clover needing help, or for grass laid in for hay.

Basic Slag.—Some of the fertilisers are not quite the same as those to which the farmer was accustomed before the War. Probably the greatest change is in basic slag. Before the War the usual high grade standard was about 40-43 per cent. phosphate, of which 80 per cent. or more was soluble in 2 per cent.

citric acid, ground to such a fineness that 80 per cent. or more passed through a sieve containing 100 meshes to the linear inch. The slag now available to the farmer is different, and the position is more complex. There are three different grades :—

1. The pre-war slag—the so-called Bessemer slag—of which there may be some, but not a great deal.
2. A lower grade containing phosphorus equivalent to 15-30 per cent. of tri-calcic phosphate, 80 per cent. being soluble in 2 per cent. citric acid. There is a considerable quantity of this. It is often described as low grade high soluble slag.
3. A still lower grade, containing phosphorus equivalent to 15-20 per cent. of tri-calcic phosphate, but largely insoluble in 2 per cent. citric acid—less than 20 per cent. usually dissolving. A considerable amount of this is obtainable ; it is sometimes described as fluorspar slag, but more usually as low grade low soluble slag.

To some extent farmers may have to accept whichever of these grades they can obtain. The change in character of the slag has been going on for several years, but it came into prominence during the War, and is permanent. Agricultural experts in various parts of the country are testing the new materials and are obtaining reliable information for farmers. Meanwhile, farmers who are offered a choice of slags will do well to consult their County expert.

Where supplies of slag cannot be obtained it will be well to inquire from the County expert into the possibility of obtaining suitable mineral phosphates. The name and address of the County expert can be obtained on application to the Ministry of Agriculture, Whitehall Place, S.W.1.

Potassic Fertilisers.—The position in regard to potassic fertilisers is somewhat interesting. The three pre-war fertilisers are all obtainable: the sulphate, the muriate and kainit. Of these the sulphate comes from Germany while the muriate and kainit come from Alsace and Lorraine, in addition to the German supplies. So far as is known the Alsatian mines cannot produce sulphate, for which the Stassfurt deposits will always have an advantage. Whether any British potash will find its way on to farms remains to be seen. The qualities are at least as good as before the War, and some of the French muriate is better than the pre-war material. The potash in pre-war muriate was usually equivalent to 45 per cent. of pure potash (K_2O), while that in the Alsatian muriate is equivalent to 50-60 per cent. of pure potash. There is no doubt that the enterprising French company which has undertaken the développement of the resources of Alsace-Lorraine will make the best of their potash supplies.

It is a little difficult to make a choice between the two substances; sulphate of potash is always safe in use, and there are cases where the muriate is said to have been inferior or even to have caused trouble. No authentic case of inferiority has come to the writer's notice, and no doubt careful test experiments will before long be made. For mangolds, grass and corn the muriate is in all probability just as useful as the sulphate; for potatoes and for tomatoes under glass it might conceivably be less useful, though no definite rule could be made without detailed experiments.

Nitrogenous Fertilisers.—The nitrate of soda is as before the War; the sulphate of ammonia may in some cases be better where more efforts are being made to remove adhering acid. There may be larger supplies than hitherto of the synthetic fertilisers, nitrate of lime and nitrolim, and farmers may also be offered trial lots of ammonium nitrate and ammonium chloride.

Lime.—None of the fertilisers described above does away with the necessity for the use of lime. The two best indicators of the need of this substance are:—

1. Failure of clover in patches, except where definite disease is present;
2. Finger-and-toe on the swedes and turnips.

Both these will be showing during the next few weeks. Where the need is established every endeavour should be made to meet it; much time and money may be lost in attempting to cultivate sour land, and there is no short and easy way of avoiding the use of lime. Agricultural committees looking for relief work might well organise the liming and chalking of areas of sour land—work that would be much more remunerative than some that is usually proposed; and if, happily, the need for organised relief never arises, they can start liming or chalking associations among farmers on the lines adopted in some of the Continental countries.

Farmyard Manure.—When all is written about artificial manures and lime, however, farmyard manure remains the commonest and the most popular manure on the farm, and unfortunately it is often the most neglected. It used to be valued at about 4s. or 5s. per ton; at present prices it can hardly be worth less than 15s. or 20s. If well made and well stored it may even exceed 20s. per ton in value, but bad making and bad storage may pull the value below 15s. and also reduce the quantity. Every care should be taken of the farmyard manure.

NOTICES OF BOOKS.

Modern Pig Feeding.—(Cambridge: School of Agriculture and Institute of Animal Nutrition.) This pamphlet deserves to be read carefully by every feeder of pigs. Mr. K. J. J. MacKenzie, the University Reader in Agriculture and Director of the University Farm, and Mr. John Fleming, give an account of four years' experiments in producing bacon on war-time rations, that is, rations in which anything that could possibly be used directly for human food was absent. For an account of the methods adopted in thus weaning, rearing and fattening pigs, and for opinions expressed by various experienced housewives regarding the resulting bacon, readers should consult the pamphlet itself, which may be obtained for the cost of postage (2d.) from the Secretary, School of Agriculture, Cambridge. It can also be obtained by agriculturists resident in the counties in the Eastern Province, by applying either to County Secretaries for Education, or County Agricultural Organisers.

The main form of concentrated food was palm kernel cake, which was used with success for the feeding of breeding sows, for weaning and rearing young pigs (to which it was given crushed into meal) and for fattening hogs. As palm kernel cake is at present one of the cheapest feeding stuffs on the market, and as prices still preclude any return to pre-war standards of feeding, the value of Mr. Mackenzie's and Mr. Fleming's work is evident.

Two other points of great practical importance, to which Professor T. B. Wood refers in his interesting preface, are: (1) The striking effect of a small addition of dried blood to the palm kernel ration of young pigs; and (2) The great effect caused by adding maize to palm kernel cake in fattening bacon hogs. It would seem probable that the dried blood provided the vitamins absent from the palm kernel cake, and when it came to fattening, the maize supplied the fat factor, which was much needed, owing to the deficiency of carbohydrates. These points, however, by no means exhaust the interest of this little pamphlet, which is stored with practical wisdom. The pages dealing with grazing also deserve very careful reading.

Insect Pests and Fungus Diseases.—P. J. Fryer. (London: Cambridge University Press, 1920, 45/- net.) This volume contains elementary explanatory material on insects and plant structure, and deals also with various insect and other pests on the zoological side attacking fruit and hops. It is divided into two parts. Part I. deals with the insect pests and insecticides, and Part II. with fungus diseases and their control.

The information is classified under headings, dealing with preventive measures, remedies and a calendar of treatment, followed by sections treating fully with insecticides and fungicides and their use. Useful tables are given for estimating the quantity of insecticide required. A few pages are devoted to insects beneficial to agriculture.

There is a section on spraying appliances and methods, followed by a copious spraying calendar, tables of weights, measures and capacity, pest duration, &c. The book is indexed and fully illustrated, including some coloured plates. The photographic illustrations, together with Plates 5 to 8, taken in colour directly from the insects, will prove useful for diagnosis and identification.

The author of this volume is the chemist to the Yalding Manufacturing Company.

Rothamsted Memoirs on Agricultural Science, Volume IX., 1909-1916.—(Harpenden: Rothamsted Experimental Station, 1919, 35s. net.)

These Memoirs, recently published, consist of a series of reprints of articles contributed by scientific workers at Rothamsted to various agricultural and scientific papers (chiefly the *Journal of Agricultural Science*). They also contain a report of an address delivered to the British Association for the Advancement of Science by Dr. E. J. Russell, F.R.S., Director of the Station, in 1916. Thirty-eight reprints in all are included in the Memoirs, and the subjects dealt with cover micro-organisms of the soil, biological conditions in the soil, weeds, rain water, and the carbohydrates in plants. The Volume is handsomely bound, and should be very useful to students of agricultural science for the purposes of study and general reference.

The Report of the Progress of the Ordnance Survey for the Year 1919-20.—(London: H.M. Stationery Office, 1920, price 1s. net). This report gives an account of the activities of the National Survey during the first year since the date of the Armistice. The importance of the work done, and its value to British farmers, is perhaps not generally realised, but the Department, by the issue of Ordnance Survey maps covering the entire surface of the United Kingdom, has done much to assist the interests of British agriculture.

Maps on the scale of 6 inches to one mile and on the still larger scale of 25 inches to one mile are available for the whole surface of the United Kingdom, except waste and mountainous areas. Copies may be obtained at all the principal booksellers, or direct from Southampton.

It is these large scale maps, particularly those on the scale of 25 inches to one mile, that are so useful to owners of property, estate agents, farmers and all who have to deal with agriculture and the land. For the price of a few shillings every owner or tenant can obtain an accurate plan of his property, on which every field and enclosure is represented, and on which the acreage of every enclosure is given.

The large scale maps are periodically revised. As would be expected, the greater number of changes occur near growing towns and villages; the features of agricultural England change but slowly; but even the maps of agricultural regions are revised every 20 years. The revision of the large scale maps is at present proceeding in Derby, Durham, Essex, Gloucester, Northumberland, Oxford and Yorkshire. It should be noted that the maps of the agricultural districts of those counties which have not been recently revised are substantially perfect, and no one need hesitate to buy a large scale map on the ground that the revision is a few years old.

The information given by a 25-inch Ordnance map is, briefly, the following:—The position of every fence, hedge, wall, ditch, river, stream, canal, road, path and railway; the position and shape of every house, out-building, wood, copse or orchard; the acreage of every parcel of land or enclosure; the heights above sea level of important objects and surfaces; the boundaries of civil parishes, boroughs, wards and unions, urban and rural districts. The map, indeed, gives a vast amount of information which could only be obtained from other sources with difficulty and at considerable cost.

Perhaps enough has been said to indicate the value to the agricultural community of the large scale Ordnance Survey, especially of the 25-inch maps.

They should be in the possession of property owners and farmers, and of all interested in the management of land. If any difficulty should be experienced in obtaining locally the 25-inch maps covering a farm or an estate, application should be made to the Director-General, Ordnance Survey, Southampton.

Sulphate of Ammonia : Increased Prices.—Owing to the increase in railway rates, which came into force on 1st September, 1920, the Ministry has sanctioned an increase in the agreed maximum prices for sulphate of ammonia by 3s. 6d. per ton. This applies to all deliveries made on or after 1st September, except when deliveries are in fulfilment of existing contracts in which no provision is made for a possible increase of price in the event of railway rates being raised. The original prices remain in force for deliveries made ex-works or by road.

A leaflet explaining these alterations is obtainable post free on application to the General Secretary, Ministry of Agriculture and Fisheries, 72, Victoria Street, London, S.W.1.

Basic Slag : Increased Prices.—Owing to the increase in railway rates which came into force on the 1st September, the Ministry has sanctioned an increase of the agreed maximum prices for basic slag (see this *Journal*, June 1920, p. 297) by 3s. 6d. per ton from the 1st September. The original prices remain in force for deliveries made ex-works or by road.

A leaflet explaining these alterations may be obtained post free on application to the General Secretary, Ministry of Agriculture and Fisheries, 72, Victoria Street, London, S.W.1.

Sale of Cereal Seed.—The attention of farmers and seed merchants is drawn to the fact that when selling wheat, barley, oats or rye for seed it is necessary, under the Testing of Seeds Order, 1918, that the seed shall be tested for germination, and that a declaration giving the following particulars shall be made in writing to the purchaser within one month of sale or delivery :—

1. The name and address of the seller.
2. The variety.
3. The percentage of germination.

If, however, the germination is at or above the standards specified in the Order, viz. :—

- 90 per cent. for wheat and barley,
- 85 per cent. for oats,
- 80 per cent. for rye,

a statement to that effect is sufficient, but if the germination is below these figures the actual percentage must be declared.

4. The date of the germination test (if made more than six months previous to sale).

It should be noted that this declaration is required in the case of a sale of cereal seed from farmer to farmer as well as from seedsman to farmer. No declaration need be made as to the percentage of purity in the case of cereal seed.

Failure to make the above declaration is a summary offence against the Defence of the Realm Regulations.

Samples of cereal seed intended for sale are tested at the official Seed Testing Station, 18, Leatham Court Road, Streatham Hill, S.W.16, for 1s. per sample. The sample sent for testing should not be less than 4 oz.

Examination of Live Bees suspected of Disease.—It is not generally known that arrangements exist at the Ministry's Bee Disease Investigation Department for the examination of live bees suspected of disease. Bee-keepers who wish to have bees examined should pack them in accordance with the instructions given on the prescribed form, No. 13.H.C., which can be obtained from County Education Committees, and should answer fully the questions regarding the history of the stock from which suspected bees were taken. Bees for examination should be sent to Dr. Helen Goodrich, The Department of Comparative Anatomy, University Museum, Oxford. The Ministry desires to emphasise the fact that *live* bees only are of any use for purposes of microscopical examination, as decay sets in very rapidly after the bees have died.

Precautions against Cattle Plague.—The Ministry announces that, owing to the appearance of Cattle Plague or Rinderpest in Belgium, an Order will come into effect immediately by which cattle, sheep, goats and swine from Belgium will not be permitted to enter British ports in future, whether as ships' stores or otherwise. Similar restrictions also apply to these animals when carried on vessels touching at Belgian ports *en route* to Great Britain, irrespective of whether the animals were actually shipped at a Belgian port or not. Hitherto, the above animals were permitted under certain circumstances to enter a British port, provided they were not landed and that the ship carrying them did not discharge or load cargo.

Importation from Belgium is also prohibited of feeding stuffs for animals (including milling offals, meals, cakes, &c.) and also of the following animal products, viz., wet hides, hoofs, horns, bones, hair of bovine animals, dried blood, beef and pork. This prohibition applies to all such products, not only of Belgian origin but to those which may be brought through Belgium by river, canal or otherwise from any adjoining country. From the start the Belgian Authorities have themselves prohibited the export of many of these materials, but it is thought advisable to provide against the possibility of premature removal of this prohibition by an Order prohibiting importation. Any of these products which are brought into a Belgian port by sea for the purposes of transhipment to Great Britain may, however, be landed in this country if accompanied by a licence granted by a British Consul at the port of transhipment in Belgium on the production to the Consul of satisfactory evidence that the articles have been taken into a Belgian port by sea solely for the purposes of transhipment.

The Ministry at the same time again calls attention to the possible risk of the introduction of Cattle Plague as well as of Foot-and-Mouth Disease by means of hay and straw used at the time of importation as a packing for foreign imported goods. Numerous imported articles, such as eggs, glass and pottery, are packed in hay or straw and a large portion of this packing may ultimately reach the farm as manure. This hay and straw constitutes a possible source of risk of the introduction of disease to the farm live stock. While the Ministry does not see its way to prohibit the use of this material as packing for imported goods owing to the serious dislocation which would result to trade, it is important that all concerned should be warned that there is at least an element of risk which can be completely avoided by not allowing it to come in contact with any animals.

The losses which would result from any widespread outbreak of either Cattle Plague or Foot-and-Mouth Disease in this country would seriously affect the general public, and the Ministry appeals to manufacturers and traders and all who receive hay and straw as a packing for foreign imported goods to take the necessary steps to prevent this packing material being sent to farms or other places, where it could possibly come in contact with live stock, and instead to make arrangements for such material to be destroyed by burning.

Leaflets issued by the Ministry.—Since the date of the list given on page 594 of last month's issue of the *Journal*, the following leaflets have been issued in the *Permanent Series* :—

No. 334.—How to Increase Stocks of Bees. (Formerly Food Production Leaflet No. 48.)

„ 352.—The Control of Pests of Fruit Trees in Gardens and Small Orchards. (Formerly Food Production Leaflet No. 39.)

In addition, the information in the following leaflets has been revised and brought up to date :—

No. 22.—The Diamond-back Moth.

„ 151.—Cleanliness in the Dairy.

„ 180.—Dodder.

„ 250.—Domestic Fruit Bottling with or without Sugar.

„ 254.—The Use of Seaweed as Manure.

„ 323.—The Profitable Utilization of Surplus Milk.

Jam-making with Brown Sugar.—The Ministry wishes to draw attention to the possibility of using brown sugar for jam-making. There are in different parts of the country at the present time stocks of free brown sugar which are being sold at prices ranging from 10½d. per lb upwards. This sugar, when used with white sugar in the same proportion as recommended in the Ministry's Leaflet No. 354 for glucose, viz., $\frac{1}{4}$ th "free" brown sugar to $\frac{3}{4}$ th white sugar, gives better results than glucose, and in some cases is cheaper. Even if a larger supply of brown sugar is available, it is not advisable to use more than one-third of brown sugar, as in most jams, with the exception of black currant, the flavour of the fruit would be considerably affected.

Exportation of Seed Potatoes to Holland.—The Ministry of Agriculture desires to draw the attention of potato exporters to the regulations which the Netherlands Government proposes shortly to issue for controlling the importation of potatoes into Holland. The Ministry is informed that, under these regulations, potatoes imported into Holland must have been inspected at the time of lifting on the field where they were grown, and must be free from Wart Disease. A certificate to this effect must be issued, as regards potatoes grown in England and Wales, by an Inspector of the Ministry, who must also be present when the potatoes are bagged. Only new bags may be used for this purpose, and they must be sealed by the Inspector, who will then issue a certificate that the potatoes contained in the bag were grown on the inspected field. Persons wishing to export seed potatoes to Holland should, therefore, inform the Ministry immediately when it is proposed to lift any crops destined for export, in order that arrangements may be made for an Inspector to be present. The fee for inspection and issue of the certificate will be £1 1s.

Rabies.—*Wiltshire.*—On the 14th August an outbreak of Rabies was confirmed at Wilton, near Salisbury, a district not hitherto visited by this disease.

This outbreak necessitated the imposition of muzzling and movement restrictions over a wide area embracing parts of the counties of Wiltshire, Hampshire and Dorset, and extending approximately from Bournemouth in the south to Wroughton in the north and from Winchester in the east to Maiden Bradley in the west. Subsequently, eight further cases were confirmed, one at Marlborough, four at Salisbury, one at Netheravon, one at Burbage and one at Potterne, near Devizes.

In view of the case at Marlborough and the additional cases in and near Salisbury, the area originally scheduled was extended so as to include the district lying within a radius of approximately 15 miles from Marlborough, and an Inner or Dangerous Area, comprising the district lying within 5 miles of Wilton and Salisbury, was declared. In this Inner Dangerous Area dogs are required to be led as well as muzzled in a public place, and also muzzled on private premises unless tied up or confined in an enclosure from which they cannot escape, and no exemptions are allowed for dogs used for hunting or other sporting purposes. Dogs are also not allowed to be moved out of this Inner Area, even to the outer zone of the Muzzling Area, without a special licence from the Ministry entailing six months' quarantine on approved veterinary premises.

The confirmation of the cases at Netheravon and Burbage, both of which lie between Marlborough and Salisbury, necessitated the extension of the Inner Dangerous Area in a north-easterly direction so as to include the whole of the country from Salisbury to Marlborough through which the Burbage dog had run. At the same time the Scheduled District was extended so as to include Andover and certain parishes on the eastern side of the district round Andover.

Glamorgan.—On the 11th September Rabies was confirmed in two fox-hounds at Cowbridge, Glamorgan, in a district which has only comparatively recently been released from restrictions. The usual Order was at once made requiring the muzzling of all dogs in an area comprising roughly a radius of 12 miles round Cowbridge, extending from the county boundary between Monmouth and Glamorgan on the east to Kenfig and Maesteg on the west, and to approximately Caerphilly, Pontypridd and Llangainor in the north. The Order also prohibited the movement of dogs out of the Area, except by licence requiring six months' quarantine on approved veterinary premises. No further outbreak has yet been confirmed in this Area.

ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous.

Long, Jas.—The Small Farm and its Management. (2nd Ed.), (Revised), (328 pp.). London: John Murray, 1920, 7s. 6d. net. [63.191.]

Wibberley, T.—Continuous Cropping and Tillage Dairy Farming for Small Farmers. (185 pp.). London: C. Arthur Pearson, 1919, 8s. 6d. net. [63.9(02); 63.70(02).]

Percival, John.—Agricultural Bacteriology. Theoretical and Practical. (2nd Ed.), (408 pp.). London: Duckworth & Co., 1920, 12s. 6d. net. [576.8.]

- Sutton, M. H. F.*—Bull. 11 :—The Electrification of Seeds by the Wolfrym Process. A Report of the Experiments carried out at Reading in 1919. (7 pp.). Reading : Sutton & Sons, n.d., 2s. 6d. net. [587.]
- New York Agricultural Experiment Station.*—Tech. Bull. 87 :—Ammonification of Manure in Soil. Pt. I. What Soil Organisms Take Part in the Ammonification of Manure. Pt. II. Taxonomic Study of Two Important Soil Ammonifiers. (45 pp.). Geneva, N.Y., 1919. [68.115; 68.16.]
- British Columbia Department of Agriculture.*—New Hort. Circ. 61 :—Making Lime Sulphur at Home. (5 pp.). Victoria, B.C., 1920. [68.295.]

Horticulture.

- New York Agricultural Experiment Station.*—Bull. 460 :—Twenty Years of Fertilizers in an Apple Orchard. (26 pp.). Geneva, N.Y., 1919. [63.42.]
- New York Agricultural Experiment Station.*—Bull. 461 :—Control of Green Apple Aphid in Bearing Orchards. (38 pp.). Geneva, N.Y., 1919. [63.27-41; 63.294.]
- West Virginia Agricultural Experiment Station.*—Bull. 167 :—Orchard Spraying Versus Dusting. (18 pp.). Morgantown, 1918. [63.41; 63.294.]
- West Virginia Agricultural Experiment Station.*—Bull. 170 :—Infection and Immunity in Apple Rust. (71 pp.). Morgantown, 1918. [63.24-41; 63.41(a).]

Live Stock.

- Kellner, Dr. O.*—Die Ernährung der landwirtschaftlichen Nutztiere. Lehrbuch auf der Grundlage physiologischer Forschung und praktischer Erfahrung. (8th Ed.), (667 pp.). Berlin : Paul Parey, 1919. [63.604.]
- Nebraska Agricultural Experiment Station.*—Bull. 173 :—Supplementary Feeds in Fattening Lambs. (24 pp.). Lincoln, 1919. [63.63.]
- U.S. Department of Agriculture.*—Farmers' Bull. 1097 :—The Stable Fly (*Stomoxys calcitrans* L.). How to Prevent Its Annoyance and Its Losses to Live Stock. 23 pp.). Washington, 1920. [59.169(a); 63.613.]
- Australian Imperial Force Education Service.*—Land Book 15 :—The Farm Horse : Its Management, Health and Feeding. (52 pp.). London. A.I.F. Administrative H Qs, 1919. [63.613.]

Dairying and Food, General.

- Orr, Thos.*—Milking Machines : Their Efficiency and Value in Modern Dairying. (18 pp.). Reprinted from "The Dairyman," Oct., Nov., and Dec., 1919. London : Offices of "The Dairyman," 1919, 6d. [63.713(04).]
- California Agricultural Experiment Station.*—Bull. 311 :—Investigations with Milking Machines. (64 pp.). Berkeley, 1919. [63.713.]
- Nebraska Agricultural Experiment Station.*—Circ. 6 :—Dairy Barn and Milk House Arrangement. (28 pp.). Lincoln : 1919. [63.6; 69.]

Birds, Poultry and Bees.

- Root, A. I. and E. R.*—The A B C and X Y Z of Bee Culture. (856 pp.) Medina, Ohio : A. I. Root Co., 1919. [63.810.2.]
- Texas Agricultural Experiment Station.*—Bull. 255 :—Beekeeping for Beginners. (25 pp.). Texas, 1919. [63.81(04).]
- U.S. Department of Agriculture.*—Bull. 810 :—European Foulbrood. (39 pp.). Washington, 1920. [63.81 : 09.]

Economics.

- Spencer, A. J.*—The Smallholdings and Allotments Acts, 1906-1919, and The Acquisition of Land (Assessment of Compensation) Act, 1919, with Explanatory Notes. (2nd Ed.), (284 pp.). London : Stevens and Sons, 1920, 10s. net. [347(b).]
- Adkin, B. W.*—A Handbook of the Law relating to Landlord and Tenant. (4th Ed.), (Revised). (286 pp.). London : The Estates Gazette, Ltd., 1918. [333.5; 333.6.]

THE JOURNAL OF THE MINISTRY OF AGRICULTURE

Vol. XXVII. No. 8.

NOVEMBER, 1920.

NOTES FOR THE MONTH.

It would seem that some misapprehension still prevails regarding the present and future prices of wheat. In the circumstances it is desirable to recapitulate here the precise position as it was stated in the House of Commons by Sir Arthur Griffith-Boscawen, Parliamentary Secretary to the Ministry, on 15th June, 1920. It is not proposed to make any change in the maximum price for home-grown wheat of the present (1920) harvest. This price, as already announced, will remain at 95s. per quarter of 504 lb.

Prices for British Wheat. The crop of 1921 is the first which comes under the operation of a free market. Home-grown wheat harvested next year, that is, wheat sown in the autumn of 1920 or the spring of 1921, will not be subject to a maximum price. The effect of this will be that if, and so long as, the import of wheat is still controlled and the farmer is thereby deprived of the full benefit of a free market, he will receive for his home-grown wheat of sound milling quality, harvested in 1921, an amount equal to the average c.i.f. cost price of imported wheat of similar or comparable quality. If wheat is not controlled, he will, of course, obtain the full economic price in a free market. He will thus be entitled in any case to the parity price of imported wheat, while, if there is any big break in prices, the Agriculture Bill proposes to give him a guarantee against serious loss.

As the Minister of Agriculture stated in his speech at Rothamsted in June last*: "At whatever price imported wheat

* The speech was published in this *Journal*, July, 1920, p. 320.

comes into this country, the farmer will get the equivalent of that price for his wheat harvested in 1921, instead of being tied down, as he has been recently, to a controlled maximum (of 95s.).” What the average world price may be for wheat harvested next year it is impossible to forecast, but, as the Minister remarked, if the farmer is protected on the one hand against serious loss, if he grows wheat, by the minimum price contained in the Agriculture Bill, and on the other, if he is to have the chance of making his profit up to the average world’s price, this should prove a sufficient inducement to bring about a largely increased sowing of wheat this autumn. He would be animated not merely by motives of patriotism, but by the fact that it will be well worth his while to do it, which, after all, is the best inducement.

(1) *Warwickshire Farm Institute*—Trials with *Yeoman* and *Svalof Iron* have been carried out on New Red Sandstone at the County Farm Institute, Marton, Warwickshire, in the three years 1917-1919, and an average yield in the three years of 45½ bushels (of 68 lb.) of grain per acre has been obtained for *Yeoman* and 48½ bushels of grain for *Svalof Iron*, as compared with 38½ bushels of grain over the average of six years for *Browick*. The plot land in 1919 was very poor, and the results in that year depressed the averages of the previous two years, which were for *Yeoman* 53½ bushels and for *Svalof Iron* 59 bushels of grain per acre. *Yeoman* has stood up well in these trials.

(2) *Cockle Park, Northumberland*.—About 5 acres of *Iron* wheat were sown with a disc coulter drill in the autumn of 1917 on land ploughed out for oats in 1917; it was previously an excellent meadow which had received repeated applications of dung and basic slag. This variety threshed out at 65½ bushels per acre. The result showed that a good second corn crop can be grown without manure after ploughing out old turf which has been liberally treated, especially with basic slag.

About 7½ acres of poor clay soil which had failed for roots in 1918 and had received 15 tons of dung to the acre was summer-fallowed and sown with *Iron*, *Yeoman* and *Benefactor* wheats. No further manure was applied. The crops of grain were (per

acre) *Iron* 59 bushels, *Yeoman* 67½ bushels and *Benefactor* 66½ bushels.

(8) *The Harper Adams Agricultural College, Shropshire.*—Seventeen varieties of wheat were sown in the autumn of 1918 on a sandy loam; 10 tons of dung per acre were applied on clover before ploughing, and a top dressing of 1 cwt. of sulphate of ammonia per acre was given to the wheat in the spring of 1919. The highest yields per acre proved to be *Svalof Iron* (own seed) 54 bushels of grain, 52 cwt. of straw; *Victor* (own seed) 52½ bushels of grain, 40 cwt. of straw; *Fox* (second growing) 52 bushels of grain, 45 cwt. of straw; *Fenman* (second growing) 50 bushels of grain, 50 cwt. of straw; *Hawk* (second growing) 49 bushels of grain, 47½ cwt. of straw; *Marshal Foch* 48 bushels of grain, 45 cwt. of straw; *Browick* 48 bushels of grain, 42½ cwt. of straw; and *Yeoman* (third growing) 47 bushels of grain, 40 cwt. of straw.

(4) *Garforth, Leeds.*—Eight varieties of wheat have been tested continuously at this centre for the four years 1916 to 1919. The crops per acre over the average of the four years were:—*Victor* 50 bushels grain, 34 cwt. straw; *Fenman* 48 bushels grain, 36 cwt. straw; *Standard Red* 48 bushels grain, 35 cwt. straw; *Squarehead Master* 47½ bushels grain, 35 cwt. straw; *Benefactor* 47½ bushels grain, 34 cwt. straw; *Little Joss* 16 bushels grain, 35 cwt. straw; *Browick* 46 bushels grain, 34 cwt. straw; and *White Standup* 45 bushels grain, 33 cwt. straw.

Svalof Iron has been tested in three years, and gave a yield of grain per acre of 52½ bushels in 1916, 52 bushels in 1918, and 42 bushels in 1919 (when yields were lower).

Yeoman has similarly been tested in three years, and the yields of grain per acre from this variety have been 47½ bushels in 1917, 51 bushels in 1918 and 40 bushels in 1919.

(5) *Midland Agricultural and Dairy College, Sutton Bonington, Loughborough*—Two tests were made on Keuper Marl with respectively 10 and 5 varieties of wheat. Seed was sown at the rate of 2½ bushels per acre early in October, 1918, and the crop was harvested on the 15th August in the following year.

In one test no manure was applied; the previous crop had been seeds, of which the aftermath was grazed by dairy cows. on land which had been top-dressed with 1 cwt. of nitrate of soda per acre. Of the varieties sown *Fenman* and *Champion* yielded each 48 bushels per acre, *Svalof Iron*, *Victor* and *Yeoman* each 32 bushels, and *Browick* 31 bushels. The order of ripening was:—*Yeoman*, *Browick*, *Fenman*, *Champion*, *Victor*.

In the other test a top dressing of 1 cwt. of sulphate of ammonia was given to land on which seeds had previously been similarly manured, the aftermath ploughed in and lime applied at the rate of 1 ton of shell lime per acre. The results of the four best varieties in this case were:—*Yeoman* 48 bushels, *Fenman* 42 bushels, *Svalof Iron* 89 bushels, and *Rivetts* 87 bushels.

(6) *South Eastern Agricultural College, Wye*.—Twelve varieties of wheat were sown at the rate of 4 bushels per acre on a calcareous loam which had previously been cropped with mangolds which received 15 tons of dung plus artificials. The best yields in these trials were (per acre):—*Marshal Foch* 49 bushels, *Yeoman* 47 bushels, *Hawk* 16 bushels, *Benefactor* 45 bushels, *Browick* 44 bushels, *Victor* 35 bushels, *Red Standard* 33 bushels, *Squarehead Master* and *Svalof Iron* 30 bushels.

* * * * *

THE use of soiling crops in general farming is dealt with by Mr. J. C. Brown in this issue in a short article (p. 725) that will

Soiling Crops in General Farming.

arrest the attention of all thoughtful and progressive farmers intent on making the most of the land. The experience of the war years has clearly shown that sound, well-drained land is capable of producing more food under arable cultivation than under grass, and with this as his text the author outlines a system of cropping calculated not only to raise the aggregate returns over a period of years, but to maintain the fertility of the land at relatively small cost.

The system is specially recommended for heavy land where a succession of forage "smother" crops would take the place of the bare fallow, and the speculative roots would serve to reinforce the pastures at the beginning and end of the grazing season, and liberate for pasturage grass land but ill adapted for hay production. Crops of pea and oat hay superior in yield and quality to average meadow hay can be obtained from arable land.

Previous articles and notes on the soiling system have appeared in this *Journal* as follows:—Farming on the Soiling System, August, 1919; Pea and Oat Hay, February, 1920; The Harper Adams Soiling Experiment, March, 1920.

THE Potato Trials at Ormskirk, now famous in the farming world, were first instituted by the Ministry in 1908 in consequence of the discovery made in that

**The Ormskirk
Potato Trials:
Report for the
Year 1919.**

year that certain potatoes are immune from Wart Disease. The first trials held were of different varieties of potatoes and of the action of chemicals on the disease.

In 1909 and 1910 trials were also begun by the Lancashire County Council on the grounds of the Ormskirk Union, but were discontinued after the immunity of certain varieties had been proved. In 1915 the late Mr. Snell, with the help of the Lancashire Farmers' Association, began similar trials on the same ground, and these have developed into what are now known as the Ormskirk Trials. Hitherto they have been chiefly tests for immunity, but in future cropping and other qualities of immune varieties, as well as potato diseases other than Wart Disease, will be investigated at the Potato Testing Station at Ormskirk, under the auspices of the Ministry and the National Institute of Agricultural Botany.

The Ministry has just issued the Annual Report of the Trials for 1919*—a most interesting publication, compiled by the late Mr. John Snell, Director of the Ormskirk Potato Station, and by Miss Evelyn Johnson, his Assistant. The Report notes that through the kindness of the Ormskirk Board of Guardians, the farm attached to the Poor Law Institution was lent once more for the 1919 trials. This land has shown itself to be thoroughly infested with the spores of the fungus causing Wart Disease. In 1919, owing to the great increase in the number of varieties sent for trial and the limited amount of land available, it was necessary, unfortunately, to conduct the trials on land which had been cropped with potatoes the previous year. Great care was taken, however, to remove any tubers left in the soil from the crop of 1918.

The light sandy loam of the trial grounds is such that, in order to obtain the best results, the soil should be moist at the time of planting. If the soil is dry at this time, subsequent rains do not penetrate, but run off the surface into the bottom of the ridges. In 1919 practically no rain fell until the end of June, and many early varieties gave very low yields, while second early varieties, such as Arran Comrade, matured

*Ormskirk Potato Trials. Annual Report for 1919 of the Trials of Potatoes Immune from Wart Disease. London: H.M. Stationery Office, 1s. 6d. net., post free.

abnormally early. In the last days of June a very strong north-west gale caused considerable damage to a number of plots. It must be clearly recognised, therefore, that in many instances the yields recorded in the Report may be due to adverse weather conditions, and are not characteristic of the variety.

The land was ploughed only once, and rotted stable manure was applied at the rate of 15 tons per acre. Superphosphate at the rate of 4 cwt to the acre and sulphate of ammonia $1\frac{1}{2}$ cwt. to the acre were also used. No potash was available. All the manures were applied in the drills at the time of planting.

The work of putting in the seed had begun during the second week of April, 1919, but certain of the plots were not complete until June, owing to delay on the part of growers in sending in their stocks. Some specimens, in fact, were not received until the third week in June. Such delay in planting does not permit the varieties to show their cropping qualities to advantage, and in future it may be necessary to fix a date after which no potatoes can be received.

All varieties were planted at a distance of 28 inches between the drills and 15 inches between the seeds, and all large tubers were cut. The Report states that the number of weak stocks sent in was very noticeable. The sprouts broke late, and were feeble and spindley. The seed did not decay in the ground, but remained hard and firm throughout the entire season. The haulm was weak and the foliage often curled, with the result that there was a poor crop of small tubers. At lifting time, some of the susceptible varieties showed undecayed sets with masses of wart attached to them, a condition not previously observed on the trial grounds. The reason of this may be that the sprouts being so late in breaking were not through the ground before the spores of the disease had become active. The sprouts were consequently attacked, and warty tissue was formed on them. As the 1918 crop was harvested under very adverse weather conditions, it is more than probable that much seed was unavoidably sweated in the clamps.

An encouraging feature of the 1919 trials was that in spite of the disadvantages under which growers have worked for the last few years, the majority of the stocks of the leading immune varieties were remarkably free from "rogues." Growers will recognise that if Wart Disease is to be combated successfully, the immune stocks must be kept free from susceptible "rogues." Stocks can be most easily "rogued" in the seed boxes when the potatoes are being sprouted ready for planting.

The badly mixed stock of Great Scot, for instance, could have been purified on the trial grounds, as it was evident at planting time that tubers with deep purple sprouts were Arran Chief, but they were deliberately planted as sent. Growers should refer to the descriptive list of the immune varieties for the colour of the sprouts. Although the degree of purity in the immune stocks was high, it was surprising to find that many of the new varieties sent for the first time consisted of very mixed stocks. The greatest care is necessary to prevent new varieties from becoming contaminated with others already in cultivation.

A notable point in the Report is the fact that during 1919, for the first time since the trials had been carried out at Ormskirk, it was observed that the climatic conditions of the season had a marked effect on the intensity of the disease. In previous years many of the more highly susceptible varieties have produced warted tubers in excess of clean tubers. During the season under review, in practically every case, the proportion of visibly clean tubers was far in excess of the warted specimens. In those varieties where the proportion of clean tubers has been, as a rule, greater than that of warted specimens, a crop of the latter was relatively much less than in previous years. The Epicure variety, for instance, of which the warted tubers gave in 1918 1 ton 12 cwt., yielded in 1919 only 3 cwt., and in another case 1 cwt. The yield of President for warted tubers fell from 3 tons 6 cwt. to 15 cwt.

During the year the Ormskirk experiments in steam sterilisation of infected soil were continued, but results were indefinite. It should be noted, however, that Professor Barker has obtained a clean crop in soil sterilised at 100°C. for 1½ hours.

The Report contains a large body of valuable information which should be of great assistance to potato growers. Among the principal features are notes on immune varieties previously tested and comparative tables showing the difference between the yield of immune and susceptible varieties, as well as an illuminating paragraph on types and synonyms. A subsidiary, but not less valuable, report is that on the cooking qualities of nine well-known varieties, but in this connection it is to be noted that the quality of a potato is largely dependent on soil. The flavour of the varieties mentioned would in all probability be different if the tubers were grown on other soils.

THE Ministry desires to call the attention of potato growers and dealers in "seed" potatoes to the Ministry's general policy with regard to the planting of first early varieties of potatoes which are susceptible to Wart Disease in Wart Disease Infected Areas.

**Planting of
Susceptible Varieties
of Potatoes in
Wart Disease
Infected Areas.**

The Ministry has now issued a general licence authorising the planting of seed potatoes of any true first early varieties, and also of the variety "Eclipse" and others of that type, in land situated within any Wart Disease Infected Area, except on land on which Wart Disease has been known to occur and on condition that the produce will be used within the Infected Areas only. It will not be necessary for growers to apply to the Ministry for individual licences for this purpose.

Licences will, however, be necessary before "seed" of these varieties may be introduced into an Infected Area, whether the introducer be the actual grower or is a dealer in "seed" potatoes. Applications for such licences should be made to the Ministry at 72, Victoria Street, London, S.W.1, and should state (1) varieties of potatoes for which licence is required, (2) the quantity of each variety, and (3) the source of supply. The Ministry desires it to be clearly understood that this concession will operate until the 30th April, 1924.

The following varieties are recognised by the Ministry for planting under this concession:—Duke of York (or Midlothian Early or Victory); May Queen; Ninetyfold; Epicure; Sharpes Express; Ringleader; Eclipse; Sir John Llewellyn; Puritan. Growers wishing to plant any other varieties of true first early types susceptible to Wart Disease should apply to the Ministry for permission to do so. No other susceptible varieties of potatoes may be planted in any Infected Area in any circumstances.

OWING to the great loss caused in certain districts by "Corky Scab," the Ministry undertook a series of small trials this

**Corky Scab of
Potatoes.**

season to ascertain if there were any varieties which did not contract this disease. Most of the varieties tested were those which are known to be immune from Wart Disease. "Sharpes Express," a susceptible variety, was also tried at one of the centres. It is to be regretted that in no case did the variety fail to take the disease. Although the resistance to it

varied somewhat at one centre, the intensity of the attack was very severe, and every tuber of "Great Scot" was attacked; "Golden Wonder" and "Flourball" were almost as badly affected, only two or three of the tubers being visibly free. In this test "King George" was not so badly attacked, but even here the disease was serious, 80 per cent. of the tubers being affected, but not severely. On another plot where "Great Scot" was attacked to the extent of 95 per cent., "Templar" had 60 per cent. of tubers affected.

The above trials took place in Derbyshire, but a trial at Gisburn in the West Riding gave a lower percentage of disease. In this case, however, it was evident that the soil was not infected to such a great extent as in Derbyshire. All varieties were attacked, varying from "Edzell Blue" with 30 per cent., down to "Ally" with 5 per cent., and "Templar" with 4 per cent. of tubers affected.

In each case the soil was heavy and constantly damp, and it is known that under these conditions, more especially when lime is present, the scab has its greatest opportunities of development.

Further experiments are contemplated next season, when it is hoped that both drainage and chemical trials may be undertaken.

THE outstanding feature of the bee-keeping industry during the past few years has been the serious depletion of the

Restocking of Bees Scheme.

number of stocks of bees in the country, owing to the so-called "Isle of Wight" disease. This disease was first noticed in the Isle of Wight in 1904, and in 1909 it spread to Hampshire and to the mainland generally. By the year 1918 the stocks had dwindled to such a serious extent that the Ministry decided to inaugurate a scheme to re-establish bee-keeping, and, if possible, to increase its extent. In order to do this it was essential not only to replace the stocks that had been lost, but to introduce a race of bees possessing some degree of resistance to Isle of Wight disease. Experiments which had already been carried out demonstrated that the Italian Bee possessed this power of resistance to a large extent. Investigations into the results of these experiments were undertaken by the Ministry's Technical Adviser on bee-keeping, and, these proving satisfactory, the Ministry decided that the main feature of the

Restocking Scheme should be the introduction of the Italian Bee.

Owing to regulations in force in Italy, however, the exportation of stocks of bees from that country was prohibited, and it was possible only to introduce Italian Queen Bees. It was therefore necessary to import from another country the stocks of bees required for the production of nuclei, or miniature stocks, to which the Italian blood would subsequently be introduced. Dutch bees were chosen for this purpose for two reasons—(1) because of their great powers of increase, by reason of which the production of nuclei would be accelerated, and (2) because they were the survivors of a serious attack of bee disease in Holland some seventy years ago, and therefore were possessed of a certain immunity from Isle of Wight disease.

To assist in the work of restocking, County Horticultural Sub-Committees were asked to form Bee Committees for their counties, to deal with the establishment of Restocking Apiaries for the rearing of nuclei and the subsequent introduction of the Italian blood. This request was responded to by 28 of the counties in England and Wales.

268 Dutch stocks were ordered, and these were brought to this country in April, 1919, without the loss of a single colony. The bees were not in modern movable comb hives, but in conical straw skeps about 2 ft. high. 251 were distributed to the above-mentioned Bee Committees, and the remainder were forwarded, also for restocking purposes, to the Irish Department of Agriculture and Technical Instruction, and to private bee-keepers, who, having heard of the proposed scheme, desired to participate, if the Ministry should have any surplus stocks in hand. In some cases the bee-keepers transferred the bees to movable comb hives, but in others the original straw skeps were retained and are still being used.

700 pure fertile Italian queen bees were ordered from a reliable queen rearer, and were delivered in consignments by registered post during the period May-August. Each queen bee travelled in a small wooden mailing cage having a chamber for bee-food, and was accompanied by a few worker bees for the purpose of feeding the queen during the journey and the period of segregation necessary before actual introduction to a new hive. 408 queens were despatched to the Restocking Apiaries, and the remainder to private bee-keepers.

During the summer, a total of 1,171 nuclei, each of which

was headed by an Italian queen reared from the imported queens, were raised at these Restocking Apiaries, and, with the exception of a few that were reserved for the following season's work, were distributed to participators in the scheme. This means that during 1919 the stocks of bees in this country had been renewed to the extent of about 1,500. These Restocking Apiaries were examined during the summer by the Ministry's Technical Adviser, and, with the exception of three only, were found to be well managed.

This initial success was a sufficient indication of the advisability of continuing the scheme in the future. For this to be successful, however, it would be necessary to continue, year by year, the importation of Italian queen bees for distribution to the Restocking Apiaries, in order that the stamina and disease-resisting quality should be maintained. Subsequent in-breeding would considerably weaken this strain, and would ultimately annul the good results already achieved.

Arrangements were accordingly made for the importation of a supply of Italian queen bees during the summer of 1920. The demand proved considerably greater than was the case the previous year, and it was found necessary to order a total of 1,600 queens.

Five additional counties agreed to carry out the Ministry's Scheme, owing to the successes achieved elsewhere. It was decided that no Dutch stocks should be requisitioned for these counties, but that the Committees should be asked to make their own arrangements for procuring the necessary stocks to form the basis of the Scheme.

The delivery of the queen bees this year commenced somewhat later than was expected, owing to postal and railway difficulties in Italy, and as a consequence, it was necessary to reduce the order to 1,555, a number of bee-keepers wishing to cancel their applications. The queens were received at intervals and re-despatched from the Ministry during the period May-September.

The results of this season's work at the Restocking Apiaries are not yet reported, but it is anticipated that a larger number of nuclei will have been distributed than was the case in 1919. A proportion of the nuclei sent out will be kept under observation, and it is hoped that in this way valuable information will be obtained as to the manner in which the imported bees have been able to adapt themselves to the climatic conditions of this country.

The scheme provides for the continued rearing and distribution of nuclei, and, with the annual importation of Italian queen bees, it is hoped that in a few years' time the bee-keeping industry of this country will have been re-established on a sound basis.

* * * * *

THE Rt. Hon. The Lord Lee of Fareham, G.B.E., K.C.B., Minister of Agriculture and Fisheries, received, on the 30th September, a joint deputation from the Scottish Chamber of Agriculture and the National Federation of Meat Traders' Associations, urging the removal of the existing embargo on the importation of store cattle from Canada.

**Importation of
Canadian
Store Cattle.**

Sir Isaac Connell, Secretary of the Scottish Chamber, briefly introduced the deputation, and observed that since the War there had been a distinct change of view on this important question.

Mr. J. E. Esslemont, a Director of the Chamber, in stating the case for the deputation, recalled the fact that the existing prohibition was imposed by legislation in 1896, with the express purpose of preventing the spread of disease in the herds of this country. At the present time, however, not only was the position with regard to disease entirely changed, but also the situation with regard to meat. Though, hitherto, this subject had been debated from the contending points of view of the feeder and breeder, it had now become a consumer's question. As disease was non-existent in Canada, it was unfair to maintain any longer what was, in effect, preferential or protective treatment in favour of one branch of the agricultural industry, under cover of an Act to keep out disease.

It was admitted that the Canadian frontier of 2,000 miles was no barrier against disease from the United States, though Scottish breeders, who were disposed to press this point, were oblivious of their own protests when an outbreak of disease in Yorkshire was considered likely to affect the export of pure bred cattle from Scotland. Moreover, all pedigree bulls exported to Canada, had to pass the tuberculin test, leaving bulls that did not pass the test to breed from in this country. By removing the embargo we would therefore be importing an even healthier class of cattle than our own. The supply of beef would be increased, and an increased output in this, as

in other commodities, would mean a reduction of prices to the benefit of the consumer. There was, further, no better way of maintaining the fertility of the land which had been brought under the plough during the War than in consuming the increased crop by feeding cattle. Assuming freights remain as they are, imported stores would cost less than the present price of the home-grown animal, and, when finished in this country, would mean much better beef than the imported dead meat, whilst the subsidiary occupations connected with slaughter and the hides would result in material benefit to the country in general. Finally, and most important of all, there was the Imperial aspect of the question, which demanded the removal of the existing restrictions in the interests of the good relationship between Canada and the Mother Country.

Councillor T. Masheter, J.P., President, National Federation of Meat Traders' Association, in supporting, drew attention to the great demand for fresh meat in contrast to that for the imported article, and submitted that the existing shortage of cattle and sheep in this country was abundant necessity for increasing the supply of store cattle. There was reason to believe that freights would, in future, be considerably lower than at the present time.

Alderman F. A. Cox, President-elect of the Federation, observed that it had been stated that the embargo was maintained in the interests of Irish exporters, and contended that any such preferential treatment was unjustifiable. The principle of the importation of cattle from Canada had, however, already been accepted by the Ministry in connection with Friesian cattle, and he submitted that the period of quarantine then imposed might be considerably reduced in favour of stores. The requirements of the United States for Canadian store cattle would probably grow less and less, which would stimulate the desire of Canadian exporters to find a market in the Mother Country.

Mr. H. A. Adams (Executive Committee of the Federation), reminded the Minister that it had been understood that the embargo would in any case be removed at the termination of the War.

Councillor J. Edwards (Executive Committee of the Federation), drew attention to the great and increasing demand for milk, on the one hand, and for fresh meat on the other, and submitted that these demands were irreconcilable and could not be met without the liberal importation of store cattle.

Lord Lee, in reply, reminded the deputation that there was very far from being agreement on this important question amongst the societies and interests concerned, in Scotland as well as in England and Wales. There had been, however, no political representations of any sort or kind, the issue being decided purely on its merits as it affected the interests of the country, and particularly the agricultural interest. It would, admittedly, be wrong to take advantage of legislation, passed to protect the flocks and herds of this country against disease, for fiscal or other purposes at other times, but the statement that the position as regards disease had now entirely changed could not be accepted in view of the facts. While there was no specific charge against Canadian cattle, the record of which was one of the cleanest in the whole world, yet the incidence of the various diseases was so obscure, their vagaries so infinite and surrounded with mystery in every shape and form, that it was not possible to import live stock from any quarter of the globe without, at the same time, incurring a certain definite risk of disease. The recent outbreak of rinderpest in Belgium was a case in point, due to live cattle from America in transit, and actually at the docks at Antwerp, coming into contact with a cargo of Zebu cattle passing from India to the Argentine. So far as foot-and-mouth disease in this country was concerned, a scientific inquiry of the most thorough kind had been recently set on foot by the Ministry to endeavour to discover the real nature of this disease and its means of communication.

Meanwhile, among those who held the opposite view to that of the deputation, there was the strongest possible feeling that the only real protection that we had at present was our insular position and the maintenance of the isolation it afforded. The permission given by the Department some time ago for the importation of certain exceptional Friesian cattle from Canada did not bear on the main question. In that case the conditions imposed, including prolonged quarantine, were not only so severe that no cattle had yet come in, but they were such as would make the proposal to import store cattle economically impossible and even ridiculous if a similar procedure were applied.

Mr. Esslemont had urged that, owing to the increased acreage under crop, it was essential that there should be more stores. The facts, however, were that, owing to existing labour conditions, the arable acreage was rapidly shrinking in Scotland as well as in England, and the war-time increase

was not being maintained. In these circumstances, it was to be regretted that, on its own merits, this argument could not be accepted. The claim had also been made that imported stores would mean better and more beef and the advantage of the offals and subsidiary occupations. With regard to better beef, that was open to argument, but with regard to the other points there was, of course, nothing to prevent the importation of Canadian cattle for immediate slaughter at the ports, which would increase the supply of fresh meat and secure the other advantages referred to. The statement that Canadian stores could be imported economically in competition with the home article was, in any case, open to considerable doubt. Apart, however, from these considerations, the main point to be realised was that the existing embargo could only be removed by fresh legislation, and there was little chance, under present circumstances, of Parliament giving its consent to any such measure. With regard to the Imperial aspect of the question, this had been taken up by the Canadian Government, but though no one could be more anxious than he, not merely to maintain, but to strengthen the ties which bound Canada to the Mother Country, it would not really help matters to gratify Western Canadian sentiment at the expense of injuring and antagonising the British farmer.

After the most careful and impartial consideration he felt bound to agree that, in view of the risk involved, the best possible security was that same moat which had surrounded these Islands and protected them from every kind of invader, including disease, for so many centuries, and he regretted to have to say that, in his judgment, the arguments that had been put forward, in favour of removing the existing safeguards, were far outweighed by the gravity of the objections which would be urged by the other side.

* * * * *

THE Ministry desires to impress upon all concerned the importance of ensuring that animals are slaughtered in a humane manner. Since the Commission, over which the present Minister of Agriculture presided, sat in 1904, there has been

**The Humane
Slaughter of
Animals.**

a steady awakening of the public conscience and a definite improvement in methods of slaughter, but there is still room for improvement, and the efforts of associations that seek to deal with the matter have not availed to introduce into this country the abattoir system which prevails on the Continent

and has done so much to make slaughtering humane. There are many private slaughter-houses over which the supervision is unsatisfactory and incomplete, and the Ministry is urging upon butchers throughout the country the advisability of killing by humane methods.

While the pole-axe in the hands of a skilled man is admittedly most effective, the requisite skill can only be acquired by practice. Young animals should always be stunned. The ordinary methods of killing, especially in the case of calves and pigs, leave much to be desired, and instructions have recently been issued to the Ministry's Inspectors to take steps to ensure that slaughtering on account of outbreaks of disease is carried out humanely, and by the aid of either humane killers or, in suitable cases, shot-guns. Officers who are compelled to slaughter animals (as in cases of foot-and-mouth disease) are also instructed to employ the most humane methods, and are further charged to see that any butchers employed by them are to observe the same principles. The Minister has in addition given instructions that all officers of the Ministry are to regard themselves as propagandists of humane methods of slaughter throughout the country, and laid it down that the main principle to be kept in view by all concerned is that every animal should be properly stunned before it is bled.

There are several humane killers on the market, and the Ministry has adopted one by Messrs. Greener, of Birmingham, which takes the form of a pistol firing a 0.22 hollow-nosed bullet, in cartridges both long and short, and is, generally speaking, capable of stunning sheep and pigs up to 24 stone in weight. In the case of small pigs or lambs, where the charge may emerge from the skull, or where the animal is being killed for food, it should be stunned with a suitable hammer or mallet. Where affected cattle are to be destroyed in the preliminary stage of an outbreak of foot-and-mouth disease, veterinary surgeons are advised to employ a shot-gun, because the effect of a charge of shot is immediate, the charge entering the brain as a solid mass and immediately spreading, thereby destroying all sensation.

The widest publicity is sought for these principles of humane treatment of animals, so long neglected in this country, and it is hoped that people who find themselves in agreement with the view taken by the Ministry will do all in their power to urge the cause of humane treatment in the slaughter of animals. It is only by the united action of all who are concerned

with the proper treatment of our livestock that improvement in the existing conditions can be brought about.

SOME misapprehension still appears to exist as to the character of the present trade in the export of horses. Before the outbreak of war in 1914, the only control exercised was that provided by the **The Export of Decrepit Horses.** Diseases of Animals Act, 1910, which prohibited the shipment from any port in Great Britain to the Continent of Europe of any horse, ass or mule, unless it had been examined by a veterinary inspector appointed by the Ministry and certified in writing by him to be capable of being conveyed and disembarked without cruelty. It must not be supposed, however, that the veterinary examination of horses for export, under the Act of 1910, was indifferently carried out; on the contrary the examination was rigorous and a high standard of fitness was enforced, with the result that complaints from the Continent as to the condition in which the animals reached the port of debarkation had practically ceased. Nevertheless, many of those interested in the humane treatment of animals considered that the trade in worn-out horses should be prohibited altogether. This view was embodied and made law in the Exportation of Horses Act, 1914, which took effect on the 1st October of that year.

In view, however, of the Royal Proclamation of the 3rd August, 1914, which prohibited the exportation of animals (including horses) on the outbreak of war, the general export trade in horses ceased for the time being. It was not until October, 1919, in response to demands from the Continent for horses suitable for agricultural and other work, that the trade in horses was resumed. Not until the latter date, therefore, did the Act of 1914 come into active operation. That Act prohibited the shipment of horses from any port in this country unless certified by a veterinary inspector of the Ministry, after examination immediately before shipment, to be capable of being conveyed and disembarked without cruelty, and also of being worked without suffering. The Act also empowers the veterinary inspector to slaughter, without the consent of the owner, any horse presented for examination and found by the inspector to be in such a physical condition that it is cruel to keep it alive, or that it is permanently incapable of being worked without suffering.

Arrangements have been made by the Ministry at the following ports for the veterinary examination of horses before export, namely:—London, Folkestone, Harwich, Hull, Grimsby, Goole, Leith and Southampton. Explicit instructions have been issued by the Ministry to its veterinary inspectors, in order to secure that in no case are horses to be shipped unless their standard of fitness for work fully complies with the requirements laid down by the Act of 1914. When the trade was first resumed in the autumn of last year, a number of horses were brought forward for shipment which were obviously below the standard required. These were rejected, and a large number of them at once slaughtered at the ports.

It is perhaps not generally known that the Horses (Importation and Transit) Order of 1916, made by the Ministry, prohibits the carriage by railway or by water of any horse, ass or mule which, owing to infirmity, illness, injury, fatigue, or any other cause, cannot be so carried without unnecessary suffering. Local authorities and police are empowered to detain any unfit horses which are intended to be so carried, and both these authorities and the railway companies are fulfilling the requirements of the law in this connection.

THE experience of recent years has proved the value to the nation both of small cultivation and of small live stock keeping.

The Keeping of Small Live Stock by Allotment Holders and Householders. The latter industry, combined with allotment work, has proved itself to be a most valuable auxiliary; and even where the breeder has no other accommodation than his backyard, the keeping of poultry and rabbits can be successfully undertaken, where the accommodation provided for the animals is in accordance with the requirements of the Local Sanitary Authority. Where space is sufficient and other conditions are satisfactory, the keeping of pigs has also proved profitable. The necessities arising from the food shortage both in this country and throughout the world make it urgently advisable to encourage to the utmost both small cultivation and live stock keeping. There is the further point that, in view of the enormous imports into this country of poultry, eggs and bacon, there is an economic opening for an immediate increase in the home production. The imports last year of poultry produce alone, for instance, are valued approximately at £35,000,000.

Where live stock is kept, it is of course essential that local sanitary requirements shall be observed. When cultivators fulfil these requirements, which should be ascertained in cases of doubt by application to the Local Sanitary Authority, no objection can be taken to their pursuits on the grounds of hygiene.

Recently, however, a question has arisen in connection with the keeping of live stock by private persons which calls for some clearer public information. It would appear from a number of letters received by the Ministry, that cases occur in which landlords do not view favourably the maintenance of small live stock by their tenants. Provided, however, that the stock can be kept under suitable sanitary conditions and without danger to public health or interference with the amenities of the district, proprietors can hardly have sufficient reason for objection in view of the present needs of the country.

The question is admittedly delicate, and as investigation into particular cases is entirely a matter for the Local Authorities and landlords concerned, the Ministry does not consider that the matter calls for any official intervention on its part. It desires, however, to clear away any possible misunderstanding that may stand in the way of increased production of food supplies. Recognising the importance of private effort in this direction, the Ministry would remind owners of property of the importance of increasing the supplies of home-grown food, and desires to point out that the keeping of live stock not only replenishes the national larder and reduces imports, but is a great preventive of waste, as the stock converts much kitchen and garden refuse into valuable human food. It is therefore hoped that where tenants of houses and allotments maintain or are prepared to maintain poultry and small live stock under sanitary conditions, the owners of such property will give their tenants every reasonable opportunity of doing so. Tenants on their part are advised urgently to take all proper care to keep their stock in sanitary condition, and to do nothing to warrant any restrictive action on the part either of their landlord or the local Health Authorities. The Ministry seeks to afford poultry keepers and small live stock breeders all possible support and encouragement.

Wide publicity is being given to its wishes in this matter, and the Ministry, in putting the case before Local Authorities and property owners, asks that they will not definitely prohibit the keeping of pigs, poultry and rabbits, but will permit it

when and where it can be carried out under suitable sanitary conditions and without danger to public health or interference with the amenities of the district.

At a meeting of the Agricultural Wages Board on the 23rd September, Mr. Acland presented a report from the Board's Committee on "Cottages," which was unanimously adopted. This report had been specially prepared in consequence of the request of the Minister of Agriculture that the Board should reconsider their policy of allowing the provision of a cottage to a worker by his employer to be recognised as a "benefit or advantage" in part payment of minimum wages in lieu of payment in cash. It gives a considered presentation of the whole position from the Board's point of view, and recommends that the Board adhere to their previous policy in the matter.

Agricultural Wages Board.

The report sets out, in some detail, the action which the Board has taken, with the reasons which influenced them, and also gives reasons for their adherence at the present time to the same policy. It will probably be of use to many persons throughout the country who have failed to appreciate the exact effect of the Board's Order, and its relation to the provisions of the Increase of Rent and Mortgage Interest (Restrictions) Act. It brings out clearly the point which is sometimes overlooked, namely, that the Orders of the Board have no direct bearing on the rents of cottages other than cottages which are provided by the employer to the worker as part of the contract for his services. Where farm workers live in cottages which are not held from the employer, such cottages do not, of course, come within the scope of the Board's Order. The report is published in full in the issue of the *Wages Board Gazette* for 1st October, 1920.

It has been decided to hold a fourth National Rat Week from the 1st to 6th November. The object of these rat weeks,

National Rat Week.

as may be generally known, is to secure, by organised and simultaneous action throughout the country, the largest possible destruction of rats. The responsibility for the destruction of rats rests by Statute upon the occupiers of premises, and it is hoped that farmers will take part in these periodical rat weeks, which should, if supported by the united action of the com-

munity, do much to remove or greatly reduce the damage caused by the depredations of these vermin.

Previous references to National Rat Weeks held in the country appeared in this *Journal*, September, 1919, pp. 579 and 628; November, 1919, p. 770; December, 1919, pp. 867, 927 and 933; and March, 1920, p. 1179.

IN the present need for increased wheat supplies, it is important to aim at a larger yield per acre. To attain this end, not only should improved varieties be sown and adequate manuring and cultivation methods be adopted, but care should be taken to sow clean seed in order to avoid as far as possible subsequent trouble from weeds.

**Importance of
Sowing Clean
Cereal Seed.**

In this connection a report has been forwarded to the Ministry by Mr. John Porter, Agricultural Organiser for Buckingham, in which it is pointed out that rye-like brome grass (*Bromus secalinus*) is overlooked by many farmers, and by others is considered to be a species of wild cereal. This obnoxious weed has made its appearance in winter cereals both in Buckingham and Hereford, very possibly owing to the seed having been present in the seed grain.

Mr. Porter points out that where farmers who grow cereal grain for seed have this weed in a crop, they should open the screen of their threshing mill a little wider when threshing; the seeds of this weed, being of about the same size as tail wheat, would be sifted out with the latter. The sample of grain would be improved and a higher price obtained, and the weed seeds could either be ground down for feed or fed to poultry.

Farmers who are in the slightest doubt as to the purity of their seed grain should consult their County Agricultural Organiser.

NOTES ON THE LINCOLN TRACTOR TRIALS, 1920.

THOMPSON CLOSE, B. J. OWEN, B.Sc. (Eng.), and
H. G. RICHARDSON, M.A., B.Sc.

THE recent trials of farm tractors at Lincoln were organised by the Royal Agricultural Society of England in conjunction with the Society of Motor Manufacturers and Traders, who were responsible for the highly successful trials of last year. The trial ground was in close proximity to that chosen in 1919, and presented very similar features. The chief difference between the two trials was the method adopted by the Royal Agricultural Society of placing machines in a definite order of merit and awarding gold and bronze medals. In certain classes where the competitors numbered only three (some reduced to a single tractor), two and one, this method had an air of unreality, and the competition was in effect restricted to classes 1, 2 and 7.

Entries were accepted under seven classes, which are set out below. It will be observed that there were three classes for internal-combustion tractors, one for steam tractors, one for "self-propelled ploughs," and two for cable sets; the last-named, it will be recalled, did not figure in the 1919 trials.

Class 1.—Internal Combustion Direct Traction, not exceeding 24 H.P., suitable for ploughing two furrows 10 inches wide by 6 inches deep.

Class 2.—Internal Combustion Direct Traction, not exceeding 30 H.P., suitable for ploughing three furrows 10 inches wide by 6 inches deep.

Class 3.—Internal Combustion Direct Traction, over 30 H.P., suitable for ploughing four furrows 10 inches wide by 8 inches deep.

Class 4.—Direct Traction Steam Engine, suitable for ploughing four furrows 10 inches wide by 8 inches deep. Engines to comply with Light Road Locomotive Acts.

Class 5.—Internal Combustion Double Engine Set, with wire rope haulage for ploughing three or four furrows 10 inches wide by 8 inches deep. Engines to comply with Light Road Locomotive Acts.

Class 6.—Double Steam Engine Set, with wire rope haulage for ploughing three or four furrows 10 inches wide by 8 inches deep. Engines to comply with Light Road Locomotive Acts.

Class 7.—Self-propelled plough for ploughing not more than four furrows of not more than 10 inches wide by not more than 8 inches deep.

Design.—Among the machines competing in the various classes there was striking uniformity in design and construc-

tion, although it is possible to divide the whole of classes 1, 2, 3 and 7 into two main types:—

(a) Those in which the whole of the machinery is built up in one block of casting, i.e., there is no frame;

(b) Those in which there are separate units on a frame.

Broadly speaking, very little difference was observed between the machines which competed this year and last year. It would seem as if for the time being the manufacturers regard design as having reached finality, and are content with minor improvements. In this connection it may be remarked that manufacturers and designers have naturally been strongly influenced by the example of horse ploughing, and have regarded the tractor as a substitute for the horse. This, and the fact that the motor car and tractor industries are closely linked, may have led to the neglect of the possibilities of the conversion of power into rotary motion; the problem is engaging the attention of French manufacturers and will require close investigation in this country. It is one, however, in which the question of the act of cultivation cannot be separated from the question of the tractor, a point to which reference is made later.

Weight in Relation to Horse-power.—In the more recent designs of tractor there has been a tendency to reduce weight per horse-power, and it was worth noting that the Fordson Tractor—the lightest of all—is only 1 cwt. per horse-power, as compared with 3 and 4 cwt. per horse-power in the case of heavier machines. It is evident, however, that the whole question of weight in relation to horse-power is at present little understood. Weight per horse-power should be, and undoubtedly will be, universally regarded as a necessary element in the selection of a machine for any particular class of work, and though this factor is already ascertainable and will presumably be indicated in the report to be issued on the trials, farmers in general have no idea of what it means in actual practice or its relation to their problems.

Caterpillar-track Machines.—Another problem is that of the relative efficiency of wheels and caterpillar track. Reference was made to this subject in the comments on last year's trials in the issue of this *Journal* for October, 1919. No definite opinion can be stated until a very protracted test is made under more varying conditions than those which prevailed this year. The caterpillar type is intended to avoid undue weight on the land. The general features of the

design are too familiar to need description. The principle is to reduce the insistent weight on each square inch of the land on which the creeper stands, and also to present a very large area for gripping or adhering to the ground. Results so far have demonstrated the superiority of the caterpillar tractor over the wheeled tractor on wet soils, where the track machine, with its low intensity of pressure upon the soil, shows itself to greater advantage than on a dry light soil. The wheeled machines practically group themselves in efficiency more or less in proportion to the weight per square inch carried, on the contact with the ground. It was clearly demonstrated in last year's trials that heavy weight is not necessary to provide tractive effort, and that, with efficient forms of grip, light machines are successful.

Many designs of caterpillar track exist, and a discussion of the merits and demerits of each would require a very lengthy statement. There is, however, considerable room for improvement in the chain track itself, as well as in its supports and anti-friction devices. The variation in resistance to haulage and to work is as great as exists between one system and another, not merely in static resistance to starting but in dynamic resistance to haulage. There is ample scope here for investigation and comparative tests at the hands of any research association or institute that may be established in connection with agricultural machinery.

Adhesion.—Adhesion depends for its effectiveness on three conditions: (1) the amount of wheel or track in contact with the ground; (2) the kind of gripping devices attached to the wheels or track; and (3) the weight of the machine. The second point, to which attention was drawn last year, especially needs further investigation. Various methods are now employed to obtain the adhesion necessary. They fall into three classes:—

- (1) Angle iron at an acute angle on the rim of the wheels;
- (2) Projecting angle iron at an acute angle to the wheels;
- (3) Various shaped spuds or spikes.

Each class employed at the trials seemed to do its work fairly efficiently, but sufficient data are not at present obtainable for comparison. There is undoubtedly considerable variation both in the adhering power of and the resistance exerted by the different devices, and a searching test should be carried out to ascertain the effectiveness of each type.

Tractor Wheels in Furrow.—While it may be doubted whether it is in every way desirable to have one of the tractor wheels running in the furrow, it was observed that when this is the case the tractor is more or less self-steering, and allows the operator to direct more attention to the plough. The furrow wheels, however, should be of such a width as not to necessitate the making of too wide a furrow.

New Improvements and New Machines.—It is not necessary to give a detailed description of the machines which took part in the trials, particularly since the great majority were competing last year. It may be remarked generally that a good deal of attention has evidently been given to points of detail with a view to ease in handling and saving of wear-and-tear.

With one or two exceptions all machines included brakes, and attention has been paid to springing. There were very few exposed gear drives, and in most instances vital parts were fully enclosed, although with due regard to the need for accessibility. In most machines provision had been made for alteration of drawbar connection in a horizontal direction, but all had not been provided with easy adjustment in a vertical direction, and those not so provided suffered in consequence.

Another point to which some manufacturers had paid attention was the application of a spring appliance for minimising the strain on the machine when the plough struck an earth-fast stone. A release device might have been incorporated with this appliance, to detach completely the plough under the strain of a heavy shock. Such an appliance should, however, be an integral part of the tractor, and not merely a casual device inserted in the drawbar connection.

Many machines were obviously too complicated for the ordinary farm hand, and the advice given last year, by a well-known farmer, that tractors should be made simple to suit the simple folk in the country, may well be repeated. A remarkable feature possessed by a self-contained machine may be mentioned: it had an electric outfit of a complicated design, which would necessitate handling by an expert mechanic, and the ordinary farm hand would be helpless at the slightest mishap.

Certain of the machines competing for the first time call for a few words of comment. In this connection it may be remarked that a well-known name is no evidence that a machine is designed on the same lines as a namesake of

earlier years; a complete change of design has been adopted in several instances where the old name has been retained.

In Class 1 the new machines were the British Wallis, the new Saunderson, the Case and the Samson—two British and two American.

The British Wallis is a modified and considerably improved pattern of the old three-wheeled American Wallis. The most obvious alteration has been the addition of another wheel, making it a four-wheeler, but there are many other detailed modifications, which add to its usefulness. The other British machine, the Saunderson, is, as regards the general principles of its design, a replica on a smaller scale of the standard model "G" tractor of the Saunderson Company. It has the same two-cylinder vertical engine and arrangement of clutch, gear-box and final drive.

The Case comes from a well-known American firm, and the machine is very original in detail design from front to rear. One-piece cast frames have been used previously, but never on the style of this machine, in which an extremely strong cast-iron member runs from front to rear, carrying on its front end the radiator; the engine is disposed midway across the frame which, at the rear, serves also to support a gear box and axle case. The Sylphon Thermostat is a useful feature of the Case. It is a device, controlled directly by the heat of the engine and cooling water, which operates to bring the engine itself, when starting from cold, rapidly to the temperature at which it will best vaporise fuel, and maintains it at that temperature throughout the whole period of its working. This effect is attained by means of a valve, which is opened or closed as the temperature of the cooling water rises and falls, and which, when closed, throttles the circulating water pipe between engine and radiator, and thus controls the amount of cooling water which passes to the engine.

The other new American machine in Class 1, the Samson, resembles externally the Fordson. An interesting feature in this machine is the lubricating arrangement. There are only a couple of holes through which oil need be poured occasionally; no other attention of that kind is necessary. The Samson is of the type of machine in which the engine and transmission case are bolted together to form one complete unit which acts as the frame of the chassis.

In Class 2 there were twenty-one machines, and of these no fewer than eight were making their first appearance in

trials in this country. Of the eight, three were of British manufacture, one was Canadian and the remaining four were American.

The British machines were the British Wallis, the Peterboro and the Pick. The first has already been referred to in Class 1. The Peterborough is designed and constructed on excellent lines. The Pick resembles, in general design, the Austin and Fordson types. The most noticeable feature is the overlapping strakes which are embodied in the back wheel construction. This arrangement is cast solid with the main body of the wheel. So designed, the wheel, even on sticky soil, remained unchoked.

The Canadian machine, the Chase, has several interesting features. It is three-wheeled, without the disadvantages usual in that class of machine: it is easily manoeuvred on the headlands by eliminating the differential gear and putting the drive on the two rear wheels under the control of the operator, who can, therefore, when turning the headlands, declutch the inside wheel and drive only on the outer.

Among the American machines, the Case is a larger edition of the model entered in Class 1. The Hart Parr is entirely new. The principal point of interest is in the engine, which is a two-cylinder, slow-running horizontal unit, transmitting through a clutch and series of plain spur wheels to the differential on the rear axle. The frame of this machine is also, in the main, a casting made extremely strong with the object of eliminating any risk of distortion.

The Twin City, another new machine, is an American product with an unusual feature in the engine; it has four valves to each cylinder, two for induction and two for exhaust. In designing the frame the manufacturers have made an interesting departure; the frame serves as a casing for the transmission gear, but does not actually form a part of the engine, which is suspended within it.

The Parrett tractor attracted considerable attention, mainly on account of its somewhat unusual appearance, caused by the large diameter and the wide spread of its wheels. This construction has a decided advantage at the headlands, since it considerably facilitates the turning operation.

Performance.—A detailed review of the trials must necessarily await the report of the Judges, but the present opportunity may be taken to give the impressions that were received in watching the machines at work.

The ploughing tests were easily performed on the light land by all classes of machines. Every machine appeared to complete its work in practically the same time, and the result approached a fairly high standard. In the case of the ploughing on heavy land the large number of competitors did not permit of each class working the same field. The competing tractors were put to work in three fields, and there was a considerable difference between them in the strength of the soil. The light machines in Class 1 found the work difficult, and, in fact, failed to plough at the required depth. The water in their radiators appeared to be constantly at boiling point, and often the draught registered per furrow in this land was as heavy as 900 lb., sometimes reaching 1,000 lb. The machines were incapable of pulling a constant load of over 600 lb. per furrow with three furrows. Undue strain was evident upon the machines, and the representatives in this class certainly took a serious risk in attempting this heavy task. The performance of other classes in the ploughing competition calls for no special comment, and will be discussed in the article which it is proposed to publish after the Judges' Report is issued.

The trial included a barn-yard machinery test, which appeared, however, to be limited to a brake load test equivalent to the power necessary to drive a 4 ft. 6 in. threshing drum. The object was clearly to ascertain roughly whether a machine was capable of driving farmyard machinery. To give results of real value, however, it would be necessary to arrange a comprehensive brake horse power test, including the determination of rated load, varying load, maximum load and half load, in relation to fuel consumption, horse-power, hours per gallon, &c. It must be recognised, however, that such a test would require more equipment than was on the ground.

A hauling test was conducted on a hilly road of good surface with a fairly sharp gradient. Many failures occurred, due invariably to the wheels slipping, and not to lack of power. Many of the machines were not equipped for such a test, and ran on smooth wheels, sometimes failing on a gradient of 1 in 9.8. Machines equipped with wood blocks and rubber treads found no difficulty in ascending the hill.

Various other tests were made to show the efficiency of the machines under all conditions.

Self-contained Machines.—It was observed that these machines were regarded very favourably by many attending

the trials. The extreme facility with which they can be steered and handled makes them suitable for short headlands and small fields. Last year the report of the judges showed a very high fuel consumption, which was disappointing, and it is to be hoped that an improvement will be indicated in the forthcoming report.

Cable Sets.—Comment has been reserved on the cable sets, which provided a new feature for this year's trials. The steam set does not require special description, but the two internal combustion sets, one manufactured by Messrs. Fowler and the other by Messrs. McLaren, deserve notice. The former is a powerful machine, each unit being a 60 H.P. petrol engine of conventional type, mounted in the usual position in front, with the shaft longitudinal. The winding drum is underneath, as in the familiar steam model, and the whole plant is very substantially built. The McLaren set is a lighter machine embodying a different design; a form of windlass at the rear did the duty of the customary suspended drum.

These equipments are likely to be highly favoured in countries where difficulties are met with in providing coal or wood fuel and a suitable water supply, and where there is an ample supply of oil fuel. It will be interesting to observe whether there is any tendency for oil to displace steam in cable ploughing in this country, but it is understood that the manufacturers have the foreign market in view, at least to a very large extent. In any case, no comparison can be drawn between the cable sets and the mobile tractor, as their work falls in entirely different classes, and only very exceptionally can they ever be in competition.

Costs.—It is to be hoped that in their report the judges will remark upon the relation of cost to units of power. The prices of tractors and self-propelled ploughs vary from about £300 to £600; but the capital expenditure is only one factor, and fuel consumption and general upkeep are points to which farmers need to pay the closest attention. It is true that in a trial of brief duration running costs cannot be estimated with any close degree of accuracy, but the facts elicited over the nine days of the trials may yet be of some assistance in establishing a basis of comparison between machines.

Conclusions.—The awards of gold and bronze medals were announced at the conclusion of the trials, and have been published in the press. Without disparaging in any way

the machines which were distinguished by the judges, it may be questioned whether the awards will in any way assist either prospective purchasers of tractors or the tractor industry. Until the judges' report is published it is, of course, impossible to know what were the precise points of superiority upon which the awards were based, but from the nature of the regulations and tests and the duration of the trials it is certain that factors which are of supreme importance could not be taken into consideration. It is very questionable whether under any conditions the competitive element is a desirable ingredient in scientific trials, but until design and construction have attained some definite standard anything in the nature of a competition appears positively undesirable, since uniformity of tests or conditions cannot be obtained. Last year's report demonstrated that even machines of the same make could not be effectively compared and contrasted under the present trial regulations. The statistics showed that identical machines ploughed altogether different acreages per hour at different cost for fuel. From this fact it may be hazarded that if similar machines underwent a similar trial to-day a series of results would be obtained substantially different from those recorded last year.

Apart from these considerations, it must be emphasised that a test of a carefully tuned machine over a few days only, and in the hands of an expert operator, affords no criterion whatsoever of the reliability or the durability of the machine in farming practice; and if this is not demonstrated, any test is robbed of the greater part of its value.

To turn to a more technical point, it may be suggested that the method of classification by the formula adopted to measure horse-power is also open to criticism. This formula was based upon the declared revolutions, the piston area and stroke. Classification by such a formula is clearly open to improvement, as it is impossible to ensure that the competitor will actually run his engine at the revolutions declared. A competitor may, on this account, put identically the same machine in two different classes, the description of the machine being similar, with the exception of the revolutions. In practice this may not be serious, and it will afford makers a chance of putting their machines into the class most suitable for them. The whole question is admittedly difficult. Based on cylinder dimension, only the extreme high speed can give the best results, although, obviously, this is the least suitable

for practical work. A suggested alternative is to classify by weight, which would give a fair standard of comparison.

The decision of the Royal Agricultural Society to require the use of similar ploughs for identical tests has met with considerable criticism, not, it may be suggested, without substance. It is understood that the object was to discover which tractor did the greatest acreage on the least fuel with a given kind of plough. The implied premise is surely a false one. Power to plough two or more furrows, is no criterion of the capacity of a machine, for conditions vary with the same plough, even with the same setting—if that is possible to obtain, which is very doubtful.

There seems no practical reason why all kinds of ploughs should not be allowed. No tractor can be tested for efficiency in ploughing if it has not a plough suited to it. As foreign ploughs were excluded, some machines were handicapped; the best results could not be obtained with the ploughs supplied, and it is evident that the results are less valuable than they would have been if every machine had the option of using the plough to which it was best suited. Drawbar pull can be stated in definite figures, and the capacity of the tractor thus ascertained. It would be better if each machine were allowed its own particular plough and if a lengthy dynamometer test, giving definite figures, were adopted. The comparison would be placed on a scientific and easily calculable basis.

With regard to the actual ploughs used, it may be remarked that they were efficient, although, as compared with American types, on the heavy side. Considerable trouble was experienced with the "self-lift" device, but this appeared to be due to adjustment and not to weakness in design. The decision to insist upon uniformity of type had the advantage of bringing home to every spectator the need for further research in the design of ploughs. It was shown without question that a plough of the same design and setting will turn a very different furrow at different speeds.

The economical speed of mechanical traction is more than double that of the horse, and the mould boards which will need to be developed are those which will perform the work with greater speed and equal excellence. To the disappointment of many tractor manufacturers, and to the loss of agriculture, plough designers have not yet put upon the market implements which will take into account the requirements of mechanical traction. Undoubtedly a great deal of patient

There are many scientific reasons which can be given in favour of the four-course rotation, but other methods of preparing land to receive a particular crop are known which are found to give quite satisfactory results. Cereals following grass are proverbially good, especially when the grass has been down for several years. Cereals also give good yields after fallow crops.

In this connection the results obtained on the Harper Adams Agricultural College Soiling Farm offer food for thought. Methods of cultivation have been tested which may have widespread application to English farming, especially in relation to economical production. One method has been established of preparing land for cereals by preceding the cereals with a soiling crop known as the Harper Adams Soiling Crop No. VI. This crop is a mixture of:—

Beans	...	...	...	...	1	bushel
Maple field peas	...	...	...	...	$\frac{1}{2}$	..
Vetches	...	...	...	...	$\frac{1}{2}$	..
Clenrotheray or Duns oats	...	...	...	...	2	..

This mixture cleans the land almost entirely of weeds, and pulverises the soil to a fineness which cannot be equalled by any form of mechanical cultivation. The ground is also fertilised as effectively as when farmyard or artificial manures are ordinarily employed. The effect of this crop on the succeeding one was clearly noticeable in the trials when the results were compared with those obtained from crops dressed with farmyard manure and preceded by rye without the leguminous plant.

The mixture gives the heaviest yields when sown in March or early April, but, in Shropshire, it has been found to give very heavy yields when sown as late as the 5th May; 20 tons per acre of green fodder can be obtained from this mixture on good land.

The possibility of growing this mixture as a grain crop suggests itself, but it is doubtful whether, in this case, the fertilising effect on the land would be equally good. There is little doubt that when a crop is allowed to ripen its seed, the land is left more impoverished than when the same crop is cut green. Fresh swede or mangold tops, when ploughed in, greatly enrich the soil for the succeeding corn crop, but little result is noticed if this green manure is allowed to decay on the surface. In the same way the unexhausted roots of the beans, peas and vetches, when the mixture is cut green, may have a greater manurial value than when the same plants are harvested ripe. The results obtained at the Harper Adams College suggest that, on heavy

clays, the bare fallow might be eliminated by growing Soiling Crop No. VI and wheat in alternate years. These crops would keep the land quite clean and in good condition without the need of any expenditure on manures, while the mechanical texture of the soil would be improved. The processes of cultivation, except ploughing and harrowing, would be performed by the crops themselves. If the crop were cut for green fodder, sowing wheat with the mixture in the spring to obviate the difficulty of autumn ploughing is worth consideration. Autumn wheat sown late in the spring stools only the first year, producing ears the second year. If the Soiling Crop No. VI is to be cut for seed this practice could not, of course, be adopted. The method is worth experiment, not only on clay land but on any land which is likely to go down to grass just at the time when wheat is urgently needed.

Soiling crops may also be grown to reinforce the pastures in early summer and in autumn, and also to produce part of the hay crop on arable land instead of obtaining the hay entirely from existing grassland. It is an established fact that average permanent grass is much more valuable for grazing than for mowing for hay, as its yield of hay is small and the quality of the produce is not always of the highest, while the land may be needed for pasturing. Instead of increasing the area of the farm under grass a much better practice would be to use the permanent grass to a greater extent for pasture, and to obtain the hay required from part of the new arable land. Heavy crops of pea and oat hay* of much superior quality to and of considerably higher yield than average meadow hay can be obtained from arable land. The crop also makes an excellent preparation for a cereal seed bed, as it leaves the soil clean and enriched.

In districts where the annual rainfall is less than about 35 inches, this method of keeping the arable land in cultivation is probably preferable to laying down new temporary pastures. In the drier districts temporary grass may fail to give a profitable return after the first year, while there is a risk that the pasture may fail to establish itself. In general, the period of high value of permanent grass is very short, and occurs between about the middle of May and the end of July. During these months the stock-carrying capacity of the land is relatively high, and if the land is stocked to its full capacity

* An account of this crop was published in this *Journal*, February, 1920, p. 1100.

at this period there will not be enough pasture for the animals when the grass begins to deteriorate in July, while if the farm is lightly stocked much inferior growth accumulates on the land. It is suggested that a great increase in the stock-carrying capacity of the country could be made by using the grass land to a greater extent for pasture, and devoting the excess of arable land to the cultivation of three of the soiling crops which have been found suitable at the Harper Adams Agricultural College. These crops may be fed to stock of all kinds on the grass land after the summer flush of grass is over. The three soiling crops referred to are:—

- (1) Crop VII, a mixture of field peas 1 bushel, buckwheat 1 bushel, and rape 4 lb. per acre.
- (2) Crop I, a mixture of giant rye and winter vetches
- (3) Crop VI (see p. 726).

Crop VII may be sown after Crop I, while Crop VI will be off the ground in time for the land to be sown with wheat or rye, for which it is an excellent preparation. A rotation of (1) Crop I, (2) Crop VII, (3) Wheat, (4) Crop VI, could be practised successfully, giving four crops in three years with one-third of the land under wheat. Crops I and VII could be used as green fodder, and Crop VI and the wheat crop allowed to ripen their seed.

Last year the experiment of planting a second crop on land which had carried a crop of pea and oat hay was tried. Several kinds of hardy kale were tested, Russian kale proving to be the best for the purpose. The kale plants were ploughed in every furrow early in August, and were not further cultivated; they rooted readily, and continued to grow until November, when growth ceased. The winter conditions were favourable, and the plants commenced to grow again about the beginning of February. In April flowering commenced, the crop being then about 4 feet high. The cows were pastured on the crop and consumed the succulent growth greedily. This plan of grazing off the crop, however, proved to be a mistake, as the land, being of a heavy nature, was badly "poached" by the treading of the animals, and difficulty was experienced in preparing it for the succeeding crop. On suitable soils, however, the practice might be worth adopting where the pea and oat hay mixture is grown. One drawback to the practice of growing green fodder crops for consumption on grass land is the cost of handling the produce, but this may be greatly reduced by using a mower, instead of the scythe, for cutting the crop, and employing a hay "bogey" with a low platform.



Showing Crop VII one month before the time for cutting. The mixture was sown on 13th June.



Showing Crop VI at the time of cutting. The mixture was sown on 6th May.
Neighbouring portions of the crop are shown side by side.

instead of a cart or wagon, for carrying the produce. It has been suggested to the writer that the operation of unloading in the field might be avoided if feeding racks carried on large wheels were constructed so that they could be filled with the green fodder and drawn to the grass field, and when emptied returned to the fodder crop to be refilled, the rack taking the place of the ordinary cart or wagon. The practice of tethering, so common on the Continent, does not seem suitable in this country, and the "poaching" of land in wet weather would undo much of the good brought about by the pulverising effect of the roots of the leguminous crops.

In conclusion, the writer would earnestly urge agriculturists to consider the suggestions here outlined. Peas, beans, and vetches are neglected crops to-day, although they figured prominently in British agriculture before the era of the turnip. They enrich the soil, and perform the work of the harrow and the cultivator. When mixed with cereals, they make a growth so dense as to destroy practically all weeds, and so make hoeing unnecessary.

We may perhaps hope that, just as in the eighteenth century the cultivation of the turnip increased the productiveness of the agriculture of this country, so may the general adoption of soiling crops on our farms mark the commencement of a new period of prosperity in the era which lies before us.

COTTAGE RESTORATION AND ADAPTATION.

MAXWELL AYRTON, F.R.I.B.A.

PRIOR to the War the repair and adaptation of old cottages to modern requirements for the accommodation of the land worker, for whom they were originally built, had practically ceased. Cottages and farm buildings were allowed to become derelict by the hundred, and only here and there a more thoughtful landlord called in expert advice to restore them to life. More often, however, such restoration was undertaken by enterprising townsmen for conversion to that creation of the last thirty years, the " week-end " cottage.

The reason for this apathy towards the improvement of old buildings is not far to seek. In the great majority of cases where labourers' cottages were wanted the work was entrusted to the estate agent, bailiff or local builder. In such circumstances it was undoubtedly cheaper to abandon the old cottages and build entirely afresh. A brick box, slate roof, imported doors and windows, and a blind eye for defects coverable by paint made it possible to satisfy the needs of the moment very cheaply in those days. The erection of new cottages also involved little trouble and less skill. The art of planning alterations and additions and the repair of existing buildings, on the other hand, is an exacting one, calling for hard brain work, experience, ingenuity and skill.

The architect, however, is rapidly coming into his own. The general public has realised the importance of his profession more in the last twelve months than in the same number of years before the War. Publications, exhibitions and the interest shown by the daily press have raised the standard of cottage planning and developed the public appreciation of good work.

It is difficult for those unacquainted with design in buildings to grasp the possibilities which lie in an old tumble-down building. To them the first solution of a problem appears the only one. How frequently dreadful botches of planning and impractical and uneconomical additions or alterations are excused on the ground that " this was the ' only possible ' way in which the work could be done ! "

It may be taken as a sound axiom that any old building which has been built on reasonably good constructive lines

lends itself to additions or alterations on at least as good lines as the original.

Such problems may be likened to a jig-saw puzzle, and should be entered upon in much the same spirit—that of certainty that, given the necessary patience and time, it *can* be solved—and that ideas must be as easily put aside as the pieces that do not fit, until the general lines are established, when the remainder will fall into place to make a complete and perfect whole.

The extremity in which the country finds itself through lack of housing has to be met by every means conceivable. The necessity for preserving every building fit for human habitation, if only temporarily, was obvious as soon as the acuteness of the present situation was realised, with the result that the work of restoration, addition, conversion and alteration is now being carried out on a much larger scale than ever before.

The importance of preserving existing houses becomes greater as each month passes, and the difficulties of the present scheme for housing become more apparent.

It cannot be urged too strongly that such work should be placed in the hands of sound architects. Without wishing in any way to detract from the capabilities of the estate agent, bailiff or builder, it must be clear that architecture is not part of their work, and they should not be expected to undertake duties obviously outside their own province.

The chief difficulty which has to be overcome in dealing with old cottages, and probably the one most frequently encountered, is dampness, and, in its worst form, rising damp due to the lack of a damp course! To cut out for and insert a damp course of slate or other impervious material is a laborious and consequently expensive operation, and also is unsatisfactory to the layman, who has nothing to show for the expense incurred, while the result can only be fully appreciated by the occupier. The man who pays perhaps naturally feels happier at the sight of a new roof, even though such an addition may not be necessary.

Much may be done, however, to remove dampness in walls by clearing away banks of earth, so often found round the sides of cottages above the ground-floor level, and by forming open brick or cement channels against the walls to carry surface water quickly away from the building. A cottage nestling deep in a group of trees, while very possibly picturesque, may

be much improved as a habitation by judicious felling, since trees hold the damp to an extraordinary extent.

Heavy creepers, on the other hand, should not be too readily condemned. Walls which, when overgrown with ivy, may be perfectly dry, are often found to be pervious to wet when stripped of their clothing.

In selecting a site for a cottage our forefathers had not the circumspection of to-day. Light, air and the natural benefits of the sun were not recognised; in fact it would appear that they were almost avoided, snugness, in a spot well protected from the force of the prevailing wind, usually being the principal consideration. In reconstructing a cottage it is sometimes advantageous to reverse the aspect so as to bring the sun into the "heart" of the house.

Much has been said about cottage planning in the last few years, but the variety of plans on which buildings may be constructed appears inexhaustible, and where one is limited by the existence of the "shell" of the house in which to plan a new interior, the problem becomes the more fascinating.

To get full accommodation and yet to keep within a strictly limited cubic capacity, in order to save in every detail of construction throughout, to provide the greatest comfort, to incur the least labour in upkeep, and at the same time to practise economy in every detail are matters which can only be handled in the light of experience.

In the actual carrying out of the work the country builder, if he is a good man (and he so often is), can be most valuable. It is a mistake often made to think that, because certain details have been drawn or specified nothing should therefore be allowed to alter them. The rural builder of the proper type is up to a thousand dodges and tips in matters of small construction and repair, not to be learned in architectural schools or offices. He will respect, and help you if you use him and his knowledge; but if he is treated merely as a means of carrying out to the exact letter what is shown upon the drawings, much good advice may be missed.

The Ministry is indebted to the Editor of "Country Life" for the loan of the illustrations which accompany this article. The illustrations are taken from "The Country Life Book of Cottages," by Sir Lawrence Weaver, who kindly permitted their use.



FIG. 1.—Lodge at Esher.

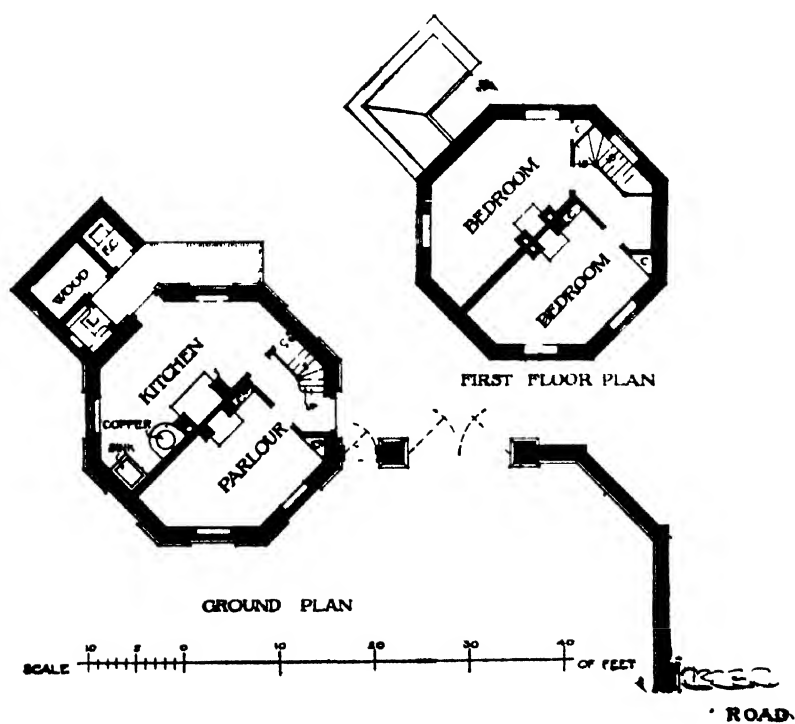


FIG. 2.—Lodge at Esher.



Fig. 3—Octagon I at Mary Place, Ohio



FIG. 4. Hotel at Hildesheim, Germany



FIG. 5. At Broad Campden, Gloucestershire

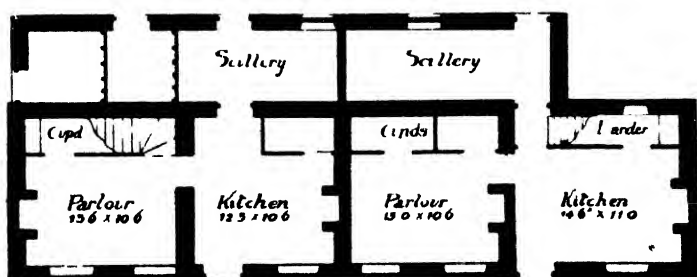


FIG. 6. Four roadside cottages altered into two and repaired at Broad Campden

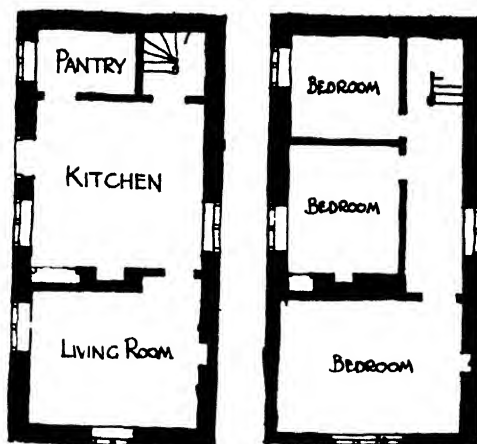


FIG 7 Ground and First Floor Plans of 'West's' as altered



FIG 8 'West's' Before Renovation



FIG. 9 — "Wests" After Renovation



FIG. 10.—JONES' COTTAGE.

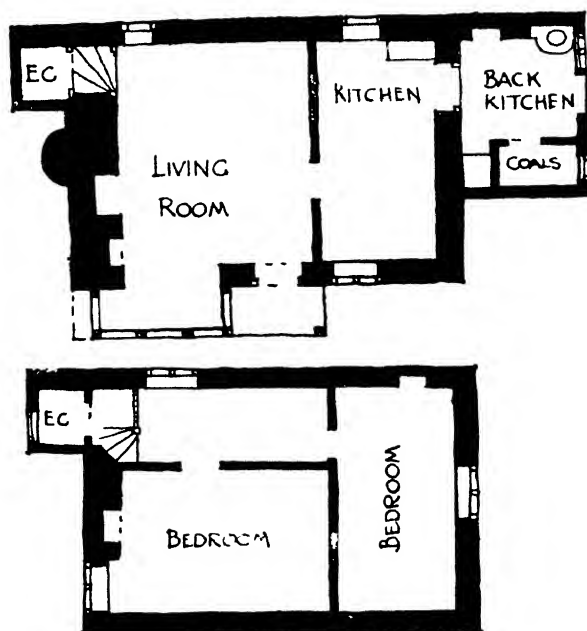


FIG. 11.—Plan of reputed Cottages called 'Jones's'.



FIG 12 - Jones's After Renovation

THE DISTRIBUTION OF WART DISEASE.*

H. V. TAYLOR, M.B.E., A.R.C.Sc., B.Sc.,

*Deputy Controller of Horticulture, Ministry of Agriculture
and Fisheries.*

In the early history of potato growing, limited cultivation had to a great extent kept the plant healthy, but when the natural and necessarily distributed culture was superseded by extensive field culture, the plant soon developed a tendency to diseases of various kinds. Owing to forced cultivation and unnatural propagation the plants were weakened, and their resistance to disease became less and less.

One reads of one disease after another attacking the crops until in the disastrous year of 1845 there occurred the great outbreak of potato disease ("Blight") in the British Isles. It was not until much later, however, that another and now considered serious disease of the potato, viz., Wart Disease, made its appearance to any great extent in this country.

Characteristics of Wart Disease.—It has been proved that Wart Disease of potatoes is caused by the fungus *Synchytrium endobioticum*. The characteristics of the disease are irregular warts or cauliflower-like protuberances, which grow from the eyes of the tubers and from buds on the rhizomes below ground. These warts may be less than a pea in size, or as large or larger than the tuber on which they grow.

Appearance of Plant.—A growing plant badly affected with Wart Disease generally shows no special features to distinguish it from other unaffected plants; though occasionally some of the lower leaves near the surface of the ground may be found to have developed into spongy-like, yellowish-green masses. These are modified leaves, and all stages are sometimes present, from a distorted warty lump, to a thickened spongy leaf, still bearing the unaltered leaf outline. On lifting a badly affected plant some or all of the tubers are found to have similar warty outgrowths, but the colour is yellowish, like the skin of the potato. In the case of potatoes growing near the surface of the soil, however, the wart may be pushed outside and develop chlorophyll, and so become greenish.

* Report of a paper read before the British Association for the Advancement of Science, at Cardiff, on 24th August, 1920.

The intensity of an attack of Wart Disease depends to some extent on the amount of water in the soil. In a dry season non-immune tubers are often found with few or no warts, even though the soil is known to be infected. The nature of the soil itself appears, however, to have little influence on the intensity of attack. All kinds of soil—sandy, clay, or medium loam—produce diseased plants, if the soil has become infected with the spores of the disease.

Origin of Disease.—The early history of Wart Disease is not known, and how the causal organism, *Synchytrium endobioticum*, came to attack the potato in this country has still to be discovered.

There is no evidence of the introduction of Wart Disease into the British Isles at any period, nor do we know if it is indigenous, living perhaps on fibrous or woody plants other than potatoes, without showing any outward sign of its presence in the form of a visible warty growth. The disease has never been found in nature on any plant other than the cultivated potato, and though in pot experiments it was found (by Mr. Cotton) on *Solanum Nigrum* and on *Solanum dulcamara*, its presence was not very marked, and might have been easily overlooked if these plants had been growing under natural conditions.

Another suggestion which may be put forward is that *S. endobioticum* (which belongs to a group of organisms of the lower fungi class, the spores of which are dispersed in the soil) may have existed in the earlier stages of its life history as a partial saprophyte, living on dead matter or plant residues and also on plant juices which had passed into the soil, and that in the course of time it may have gradually adapted itself to the potato, when certain highly susceptible varieties came into commerce.

This is, of course, only a matter of conjecture, but, if *S. endobioticum* is indigenous, and was present either on some wild plant without producing any deformation, which would call attention to it, or living in the soil, it is strange that the disease did not develop on the potato until after more than a century and a half of extensive cultivation, for field cultivation of the potato was general in England from 1728, and the earliest definite record of the presence of Wart Disease was made in 1898, though statements have been made by many that it existed for some considerable time before this date.

In support of the "indigenous" theory, therefore, we must assume that, if *S. endobioticum* was present at the time on other

host plants without being noticeable, or if it completed its life cycle in the soil as a soil organism without attacking any plant, the varieties of potato then cultivated must have possessed the characters of immunity from the disease—or that the fungus only acclimatised itself to live on these potatoes at a later date—but that, as these old resistant varieties were displaced by newer kinds, the fungus, finding in the newer varieties suitable hosts, gradually adapted itself to these and commenced a period of its life on the potato.

If, on the other hand, *S. endobioticum* is not indigenous, how was it introduced into this country? It is hardly possible that it could have been brought with the original potato from South America, as all the varieties from Chili which have been tested have been found to be immune, and in any case, if the disease had been introduced with the original potato, it is probable that the fungus would have made itself evident at a much earlier date, both in this country and in Germany, Spain, Austria and Belgium.

It is a matter of common belief in certain districts that Wart Disease was introduced into this country (with potatoes) from Germany, but there is little evidence in support of this statement. Wart Disease is present in Germany to a limited extent. It is found chiefly in West Germany (Rhine Provinces), and to some extent near Hamburg, and in Holstein. There are scattered cases elsewhere, but there is no evidence that it has been prevalent in the fields until recent years. All the available records go to prove that Wart Disease is more prevalent in the British Isles than elsewhere.

Early History of Disease.—Many gardeners and farmers in Lancashire and Cheshire have stated that Wart Disease was present in England in the 'seventies, and a number of people appear to have recognised it about that time.

It is not always wise to accept statements as to the presence of a disease many years before, unless the statements can be supported by facts. Wart Disease, however, is so characteristic, and is so different in appearance from other potato diseases, that more value than usual may be placed on the truth of these statements. If the statements are correct, it means that long before the scientific world knew of the existence of this disease, it had probably firmly established itself in cottage gardens in Lancashire, Cheshire and Shropshire, in North Wales, and in certain parts of the South of Scotland.

On very reliable authority the disease is said to have been present in potato crops in Haddington (Scotland) as far back as 1876.

One of the earliest reliable statements is that of Professor Newstead, who states that he remembers seeing it at Upwell, near Wisbech, in 1878; this is curious, since no disease has been discovered there since.

The first scientific record of the disease is that given by Schilbersky in 1896 (Hungary), but it has not been proved that it was actually present in Hungary at that time. A curious fact, however, is that one of the earliest definite records of the presence of the disease in potatoes in England is that published by Mr. Arthur Sutton (of Reading), who stated that his firm in 1898 received a specimen of potato affected in a peculiar way from the late Mr. W. Kerr of Dumfries. The specimen was stated to have come from Birkenhead, the variety being *Imperator*, grown from seed imported from Hungary. The disease was not recognised at that time, and was referred to by Mr. Sutton as "rust."

Mr. Nield, of the Holmes Chapel Agricultural College, Cheshire, first learnt of Wart Disease in 1895, and records that it was commonly believed in Cheshire that the disease was introduced by cattle boats arriving at Birkenhead.

Dr MacDougall, in "The Transactions of the Highland and Agricultural Society of Scotland" (1903), writes that Wart Disease was first brought to his notice in 1899, among new seed potatoes sent from Cheshire.

The late Dr. Wilson, of St. Andrews, was the first to publish a record of the appearance of Wart Disease in Scotland. He states in his paper that a specimen was sent to him from Colinsburgh, Fife, in 1901, but, as previously stated, its existence in the Lothian districts of Scotland probably dates back to a much earlier period.

The disease was reported from Wales in 1901, and from Ireland in 1908.

From these scattered data we may safely conclude that Wart Disease has been present in this country for many years. The slow spread of the disease in these early days is a matter of some surprise, but it must be remembered that in the earlier stages of its history it spread locally, and when one takes into consideration the fact of a four years' rotation, it is easily understood how the disease would take some time to make itself evident to any extent.

It was not until 1907 that the serious nature of Wart Disease was generally realised by scientists. It became obvious at that time that it was increasing in intensity in infected districts, although growers were not inclined to believe that the disease would cause any commercial loss in the crop.

In 1908 an inquiry made by the Board of Agriculture into the nature and extent of the disease in England, Wales, and Scotland revealed that in certain areas, especially Lancashire, Cheshire, Staffordshire and South Scotland, the disease was extensive, and had been present for many years, and that certain varieties, viz., Conquest, Snowdrop, Golden Wonder, and Langworthy, appeared to resist the disease, although Up-to-Date growing alongside suffered severely.

Before dealing with the way in which this second discovery was made use of, it is necessary to pursue the history of the spread of the disease.

Spread in Recent Years.—In 1910, as in 1908, Wart Disease was chiefly confined to the counties of Lancashire, Cheshire, Staffordshire (and certain other counties in the Midlands), South Scotland, with a few cases in North and in South Wales, and isolated outbreaks in other parts, *e.g.*, Huntingdon, Cambridge, Middlesex, Berkshire, Cumberland and Yorkshire (West Riding).

Although, after a further period of three years, considerably more Wart Disease cases were known to exist in the country, the disease being more widespread in the old infected parts than hitherto, its actual spread to other parts of England was limited to a few outbreaks in counties which had hitherto been supposed free from disease, viz., Northumberland, Durham, and Westmorland in the North, and Somerset and Wiltshire in the South West.

By the end of 1916 Wart Disease had attained a firmer hold throughout the country and had spread in the former infected districts, especially in Wales and the West (the result it is said of planting seed from the infected districts of Lancashire). Outbreaks of the disease had also appeared in the extreme South, viz., in Dorset and Hampshire, and also in the South East (Kent), but generally the Eastern and Southern potato districts still remained clean.

A survey made at the end of 1919 shows that Wart Disease is now widely spread throughout the whole country, and that there is probably no county free from this disease. There is no doubt that the disease has made steady progress east-

wards at an alarming rate since 1916, several fresh cases having been notified from Lincolnshire and the East Riding of Yorkshire.

It had also spread in a south-easterly direction, outbreaks of importance having occurred in Surrey, the Home Counties and Kent.

Any explanation of the spread of infection must account for three essential facts:—

(1) The appearance of the disease as of economic importance from 1907 onwards.

(2) The greater concentration of the disease in the North and West, and the comparative freedom of the East and South.

(3) The relative suddenness of the spread of infection on the Eastern and Southern side since 1914.

The only possible explanation which will account for this geographical distribution of Wart Disease is that the main agent in the distribution of the disease is "seed"; although the variety of potato commonly grown at different periods may have determined the economic importance or otherwise of the disease.

(To be continued.)

PLANT BREEDING WORK AT ABERYSTWYTH.

PROFESSOR R. G. STAPLEDON, M.A.,

Plant Breeding Institution, Aberystwyth.

The first part of this article, published in last month's issue, contained a description of the Plant Breeding Station which has been formed at Aberystwyth for the purpose of improving and breeding strains of agricultural plants suitable for Welsh conditions. An account was given of investigations which have been conducted as necessary preliminaries to the actual breeding work with herbage plants. The writer pointed out that two methods are now being employed at Aberystwyth, namely, the collection of seed and the digging up of plants in toto and planting them in gardens. As a first step the seed of indigenous grasses is being collected more or less in bulk from several different districts, in order to ascertain how indigenous seed (without special selection) compares with the ordinary commercial and imported stocks. Cocks-foot, tall oat grass, crested dog's tail, meadow foxtail and Timothy were in the first instance collected and sown, and perennial ryegrass, tall fescue and rough-stalked meadow grass have since been added to the species under preliminary investigation.

INVESTIGATIONS relative to the improvement of grassland, conducted by the writer, have led him to formulate the following hypothesis as a guide to the selection of herbage plants. First, it is desirable that the plants should be late in flowering; even our native herbage plants flower and mature too early, with the result that the maximum grazing season is restricted. This evil has been well expressed by Brown,* who states, for

* Brown, Jas. C. "Dairy Farming on Arable Land."

example, that "grassland dairying is not a very perfect practice, owing to the rapid falling off in the milk-producing qualities of the grass after the month of June." For hay, early maturity is a great drawback, especially in districts where the hay is habitually cut too late. Gilchrist has advocated New Zealand cocksfoot on account of its later maturity. The value of meadow foxtail as a meadow grass, also, is much reduced by its particularly early maturity. *Secondly*, all the available evidence goes to show that a leafy herbage is more nutritious than is a stemmy herbage; it is only necessary to cite Hall's and Russell's work in this connection.* *Thirdly*, it would seem evident that the plan of selecting for maximum output of dry matter per acre as opposed to gross produce per acre would be applicable to grass improvement just as to roots. Thus the aim must be to produce grasses which flower and mature late and which yield the maximum of leafy (as opposed to stemmy) dry matter per acre per annum; and since the temporary ley of 4-6 years' duration is an important feature of grass land management in the West, the ideal grass must also be capable of uniform productivity over a 4-6 year period.

Up to the present experiments have been conducted more fully with cocksfoot than with any other grass. Twenty-four different lots, representing indigenous, Danish, American and French stocks were sown in small beds in the spring of 1919.† Each bed consisted of four rows 9 in. apart and 56 in. long. During the past spring and summer hay was cut from the rows on different dates, and the aftermaths cut at regular intervals. It is not necessary here to enter into details of the interesting results obtained, but reference to Table I, which gives the average gross produce from the beds of each nationality, and to Table II, which gives the gross produce of the best and worst lots, will reveal important facts.

* See *Jour. of Agric. Science*, Vol. IV. (4), June, 1912. It is obvious, of course, that "leafiness" is much influenced by habitat, but Hall's and Russell's data do not preclude the possibility of strains existing with a potentiality for leafiness.

† It was unfortunately not possible to obtain New Zealand seed for inclusion in these trials; seed from New Zealand has, however, been procured for subsequent sowing.

TABLE I.—A comparison of the total produce in hay and aftermath cuttings from cocksfoot nationality trials. The results given are the average produce per bed, each bed consisting of four rows 56 inches long. The average percentage of leaf in the hay (average of the four cuttings at different dates), and the average number of tillers per spaced plants of the same nationalities after ten weeks' growth, are also shown, together with notes as to the time of maturity of the several lots.

Nationality and No. of Beds averaged.	Weight of Hay in Oz.	Total Weight of Aftermath cuttings (green) in Oz.	Weight of Hay and Aftermath (green) in Oz. together.	Average Percentage of Leaf in Hay.	Average No. of Tillers per spaced Plant when 10 weeks old.	Remarks as to relative Dates of Maturity.
Indigenous (6) ...	50.04	55.04	105.08	37.65	18.2	8th June, 1920 : no anthers exerted on 2 beds, but a few exerted on 3 beds, a few dehiscent on one bed only. 19th July, 1920 : practically no seed shed from any beds, 2 beds not dead ripe.
U.S.A. (6)...	52.00	43.80	95.80	24.60	16.1	8th June, 1920 : anther dehiscence completed on 1 bed ; on remaining beds slightly more than $\frac{1}{2}$ completed. 19th July, 1920 : seed dead ripe on all except 1 bed. much seed shed from the majority of beds.
Danish (10) ...	46.72	40.52	87.24	25.50	13.8	8th June, 1920 : anther dehiscence completed on 1 bed, nearly completed on 4, about half completed on remainder. 19th July, 1920 : all beds with seed dead ripe, most of seed shed from 2 beds and much shed on all beds.
French (2) ...	46.37	33.28	79.65	24.70	12.8	8th June, 1920 : anthers on practically all panicles dehiscent, 19th July, 1920 : dead ripe and most of the seed shed.

TABLE II.—Showing the results given by the 9 (out of 24) lots of cocksfoot with a total yield of over 100 oz. per bed; the figures for the poorest sample of each nationality are also given.

Reference and Nationality.	Weight of Hay in Oz.	Total Weight of Aftermath cuttings (green) in Oz.	Weight of Hay and Aftermath cuttings (green) in Oz.	Average Percentage of Leaf in Hay.
Bc. 20 Indigenous ...	65.50	The nine best yields	139.50	35.5
Bc. 21 Indigenous ...	60.00	74.00	115.70	26.8
Bc. 15 Danish ...	59.75	55.70	114.30	23.7
Bc. 17 U.S.A. ...	57.25	54.55	114.25	26.4
Bc. 13 Danish ...	61.75	57.00	114.25	31.0
Bc. 19 Danish ...	56.50	52.50	114.00	28.0
Bc. 16 U.S.A. ...	58.00	57.50	108.25	23.9
Bc. 24 Indigenous ...	51.50	50.25	104.00	46.8
Bc. 18 U.S.A. ...	52.00	52.50	103.50	23.6
The poorest yields of each nationality.				
Bc. 2 Indigenous ...	35.50	47.50	83.00	43.00
Bc. 11 U.S.A. ...	40.00	33.00	73.00	21.90
Bc. 10 Danish ...	38.25	30.25	68.50	22.30
Bc. 4 French ...	38.25	28.75	67.00	23.90

It will be noticed that the indigenous plants were on the average very decidedly more leafy* than the foreign, and also appeared to possess the ability of greater tiller production. Of the twenty-four lots only one indigenous bed gave less than 30 per cent. leaf, and only one foreign (Bc. 13 Danish) gave over 30 per cent. leaf. Selected clumps put out in spaced rows showed similar results,† the foreign giving an average leafiness of 38 per cent. and the indigenous 49 per cent. Plate VIII shows the average difference in leafiness between an indigenous (Bc. 115) and commercial Danish (Bc. 75) clump.‡

In the matter of lateness, also, the advantage was entirely with the indigenous plants. This was confirmed by the behaviour of the selections, only one or two clumps being as

* The leaves were cut off from the stem at the ligule, so that, strictly speaking, "leaf" as here understood means the lamina only, and not lamina and sheath.

† Transplanting appears on all occasions to add to the relative leafiness of grasses.

‡ It cannot be asserted with certainty that the "plants" in each pot are definitely single plants, although when dug up from the beds in which they were sown and put out in "selection rows" they were thought to be so. They were only potted for the purpose of being photographed.



PLATE VIII —Contrasting the leafiness of an indigenous Cocksfoot (=Bc 115)
with that of a foreign one (=Bc 75=Danish)

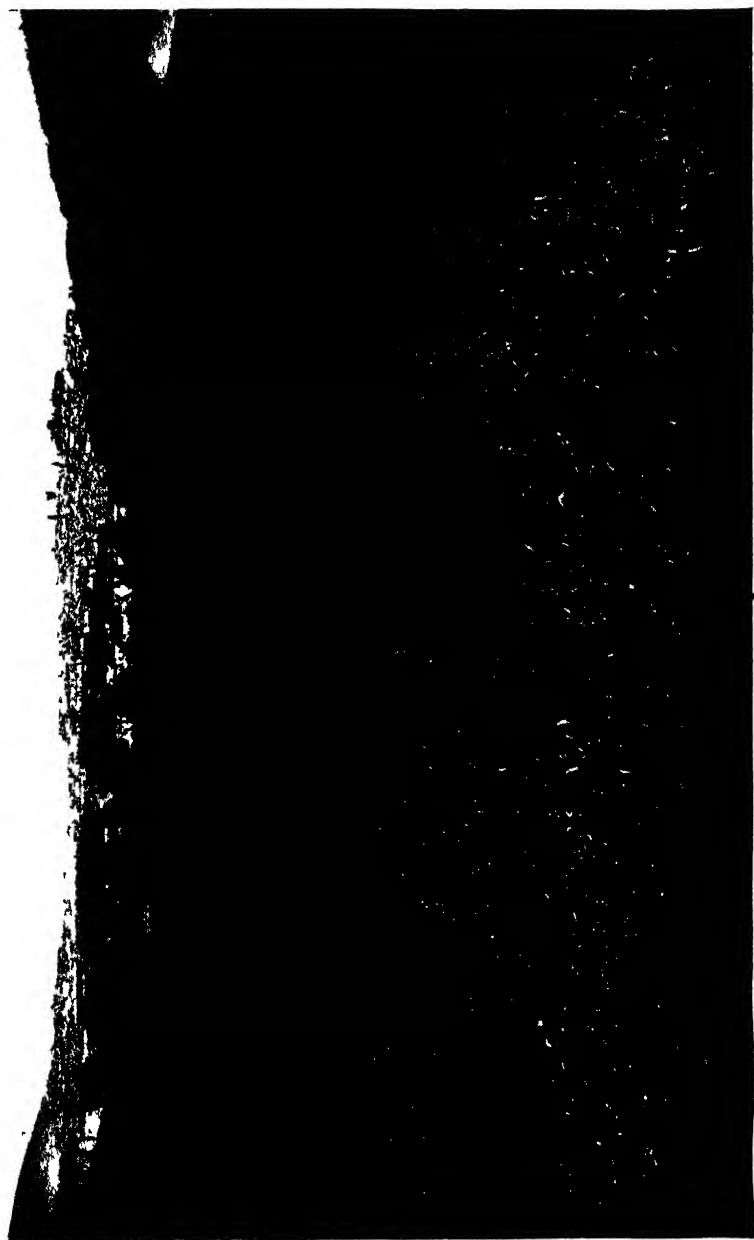


PLATE IX.—Showing the arrangement of the Oat Plots on the field. Note the dividing Rye Paths between the beds ;
the rye shows relatively dark in the photograph.

early as some of the later foreign selections, both the beds and ~~the~~ selections tending to show that the average order of maturity is:—France, Denmark, United States, indigenous. The gross produce from the indigenous, furthermore, averaged better than that from the foreign. The greatest gain, however, was in the aftermath cuttings, the samples from the United States giving a slightly higher hay figure than the indigenous. None the less, the heaviest hay yield was obtained from an indigenous plot.

These results are, of course, only to be regarded as tentative, but they have been referred to as showing the great difference that undoubtedly exists as between different lots of the same grass, and also in order to emphasise the fact that there is an undoubted potential usefulness in the selected seed of our indigenous herbage plants. The poorness of the French samples is striking, but it must be noted that these figures are based on the results of only two samples. The range of productivity of all the lots is a sufficient commentary on the need for devoting to herbage plants the same care as is given to cereals and roots, as even adjacent beds showed a disparity of over 18 per cent. Timothy and tall oat grass appeared to behave in a similar manner to cocksfoot, although the comparisons in the case of these two grasses have not yet been conducted on an extensive scale, and the two lots (only) of indigenous Timothy tried did not bulk as heavily as the commercial. It has not yet been possible to make numerous dry-weight estimations, and the degree of perenniality of the lots under investigation can only be arrived at after a lapse of a number of years.* The preliminary trials with crested dog's tail did not show such marked differences as those referred to above; indeed, the commercial lots have tended to bulk the heaviest, but the highest percentage of dry matter was obtained from an indigenous sample.

Meadow foxtail was not compared with commercial strains during the first year. The various indigenous lots, however, exhibited considerable differences in, *inter alia*, the matter of

* It would seem likely, however, that grasses grown from indigenous seed, like the seed of wild white clover, would prove to be longer-lived than plants from imported stocks. This would seem to have been so in the case of some of the ryegrass strains referred to by Peter Lawson and Son, and which were apparently so built up. Stapledon and Jenkin ("Pasture Problems," *Jour. of Agric. Science*, Vol. VIII. (1), September, 1916) have shown, moreover, that perennial ryegrass as an indigenous self-sown plant is usually much longer lived than are the plants derived from the sowing of commercial seed.

time of maturity, so that the selection of late strains may prove to be a possibility.

Data are naturally not yet available to indicate whether the generalisations that it has been possible to make between indigenous and commercial cocksfoot will apply equally when the plants are two or more years old, or whether "once-grown" commercial cocksfoot will behave in a manner more like indigenous. The preliminary work, however, would seem to suggest that, despite the undoubted influence of habitat on such characters as leafiness, time of maturity and tillering, it may nevertheless be possible to isolate strains with inheritable strong potentialities in the directions most desired. This season, as a natural outcome of the work, numerous selections have been made from local indigenous cocksfoot plants, and plants have also been obtained from several English counties. Endeavours will be made to ascertain the degree of stability of the various morphological characters of the plants by growing separated tillers of characteristic plants under different controlled conditions of habitat. In this connection it may be remarked that, although perennial wind-pollinated grasses present numerous difficulties to the breeder not experienced in the case of the annual and not readily naturally crossing cereals, the perennials at least have the advantage that one and the same plant can be divided into numerous tillers, and that groups of plants so produced can, if necessary, be moved from one habitat to another. Thus selections can be conducted under conditions of extreme rigour, while the actual plants selected can be brought to a more congenial habitat for the purposes of controlled pollination and seed production.

An important economic aspect of herbage work is the question of seed production. Experience must show whether reasonably good crops of clover and grass seeds can be grown and harvested with sufficient certainty under the climatic conditions prevailing in the College area. Small-scale garden trials have proved hopeful in this direction, and these have been followed up this season by the sowing of about five acres with the commoner grasses and clovers on the Danish plan with seed production lines (about 2 ft. apart).

Cereals.—In Wales oats must be regarded as the most important grain crop, and investigations with this cereal are therefore being started. Two distinct types of oats are required, the one for cultivation at high elevations near the

extreme limits of oat cultivation, and the other at lower elevations under general conditions of high rainfall.

At the higher altitudes *Avena strigosa*, known as "Ceirch Llwyd" or "Teify" Oat, is extensively grown, and the grain and straw obtained is chaffed together for horse feed; the usual practice is only to thresh enough grain for seed purposes. The local black oat, "Ceirch du Bach," is also grown under similar conditions in Cardiganshire and parts of Pembrokeshire, its place being taken in Radnorshire by the Radnorshire Sprig or Welsh Sprig Oat. Potato, Tartar, with the local black oats and some of the newer varieties, especially Abundance, are grown at the lower elevations. Early maturity and an ability to stand are essentials in an oat grown under the conditions prevailing, while a straw of good feeding value is also necessary, since the great majority of the oats grown, at all events in West and Central Wales, are for consumption on the farm. Preliminary work is being undertaken in three directions: first, a critical study and analysis of the local or "land" oats; secondly, a systematic study of oat varieties in general; and thirdly, yield trials with the varieties in commoner use in comparison with the local oats. It has been found, for instance, that samples of Ceirch du Bach, in addition to containing the grain of other varieties (chiefly the Teify Oat and Potato) also give rise to several forms which are to be regarded as different types of this "land" oat. It is probable that five forms will be isolated from the current plots. The most interesting is perhaps a grey grained type similar in other respects to the commonest black type, and which appears to breed true to greyiness.

It cannot yet be said whether the grey and other forms that have been identified will prove to be of economic significance; these are, of course, being isolated with a view to the possibility of ultimately working up pure lines from those forms which preliminary mass selection proves to be of the greatest value.

The most important aspect of this season's work has been the critical study of varieties. This has been undertaken with two ends in view: (1) to prepare a key to the identification of oat varieties, and (2) to contrast and study the earliness or the reverse and other agricultural properties of the varieties, with the ultimate object of making judicious selections of parents for hybridization.

It has been the endeavour at the Station to grow as many

varieties as possible, and as a result of valuable help given from numerous sources, as many as 154 varieties have been included in these trials.* In order to test the purity and trueness to type of the varieties as obtainable on the market, several "lots" of all the more important varieties have been grown. The oats were sown in the field in thin drills 20 ft. long and 14 in. apart, all the beds being divided by rye paths. This trial was set up in the middle of about a 3-acre breadth allocated to oat experiments, and the rye paths made the whole a homogeneous cereal field. The effects of edges were thus obviated and damage from birds lessened.† As an additional safeguard a small patch of each variety was sown in the cage, but this has proved not to have been necessary, for the "take" in the field has been excellent, and birds have not proved unduly troublesome.

This is not the place to anticipate the results that have been derived from the work. The systematic study of oat varieties is being undertaken by Mr. C. V. B. Marquand, who has approached the problem not only from the point of view of the systematist, but also with regard to the agricultural potentialities of the several varieties. It is hoped to publish a full report of the work in due course.

It is interesting to remark, however, that the cultivated varieties of *Avena sterilis* have proved to be considerably earlier than the *A. sativa* varieties grown in this country. Thus, the Algerian oat sown on 8th December came into ear 21 days earlier than both winter and spring varieties sown on 6th November. Burt, Red Rust Proof and the Algerian oat sown with the other varieties in drills in the field on 22nd March were the first to come into ear and ripen, being at least six days earlier than any of the *A. sativa* varieties normally grown in this country.

The yield trials were conducted on the small plot plan. Rod plots sown at the rate of 3,000,000 grains per acre have been employed, with rye-dividing paths. About 40 varieties, involving 150 rod plots, have been tested this season. The *American*

*Thanks are due in particular to Dr. Taylor, Chief of the Bureau of Plant Industry, Washington; Professor Zavitz, of the Agricultural College, Ontario; Dr. Dorph Petersen, of Copenhagen; Dr. Trabut, of Algiers; to Messrs. Vilmorin, of Paris, and Messrs. Haage Schmidt, of Erfurt, for help in the collection of foreign samples; to Dr. W. G. Smith, Mr. T. Anderson, Mr. C. B. Saunders, Professor White, and Mr. G. Miln, of Gartons, Warrington; and to the following seedsmen:—Messrs. Temperley, Dunn, Toogood, Webb and Carter, for assistance in the collection of both foreign and British samples.

†The cereal path plan is largely adopted at Svalöf, and the experience of the present season has proved it to be an excellent procedure.

*Sixty Day** came into ear 12 days earlier than any other variety.† It did not actually ripen, however, any sooner than *Dala* or *Yielder*, but shared first place about equally with these.‡ The Irish Tan oat§ has evoked favourable comment from hill farmers; it is very decidedly earlier than *Ceirch du Bach*, and would seem to produce an abundance of straw, and it may well be worth consideration for our hilly districts. Of "grain producers" but slightly or never grown in the district *Victory*, *Crown*, *Banner* and the Danish Oat, *Gul Naesgaards*, have the appearance of yielding heavy crops.||

It has been noticed that the potato and closely related varieties have been attacked by both smut and rust to a greater extent than any other group of allied varieties.

Yield trials will be conducted on a greatly reduced number of varieties next spring, and will be followed up for several years; the duplicated small plot will form the basis of all the trials. One object of the trials set up during the present season has been to experiment with the management and technique of small plots, as it is intended to conduct all trials at Headquarters on this plan.

The general arrangement of the cereal plots is shown in Plate IX. It may be remarked that the sowing of these numerous small plots did not prove to be such a serious undertaking as was anticipated. All the beds and plots were measured out some time before sowing commenced, and the drills for the oat rows were drawn from three weeks to a fortnight before the grain was sown. About three-quarters of the 1,080 rows were actually sown in one long day by a party consisting of four of the scientific staff and five of the garden staff. The paths were largely sown during adverse weather conditions.

The preliminary work on oats has shown that in normal circumstances the average hybridization season will be a very short one at Aberystwyth. The effective flowering period will

* The seed of this variety was obtained direct from America by the Ministry of Agriculture, which was able to place a portion of the grain at the disposal of the Station.

† It was not possible to procure a sufficiency of seed of any *A. sterilis* variety for inclusion in the rod plot yield trials.

‡ The slow ripening was doubtless in part due to wet weather, of which these early exerted panicles had a longer period than the later produced panicles of *Dala* and *Yielder*.

§ This oat was included in the trials on the advice of Mr. P. G. Dallinger, of the Ministry of Agriculture, and samples were obtained through the kindness of Mr. Pimlott, of the Irish Department.

|| A full report of the yield trials will be published as a College Bulletin early next year. The plots will be threshed on the field. Practically all of the plots have been cut at the time of writing this article (September 14th).

consequently have to be lengthened by every means possible. Three plans are under experiment, viz., (1) resort to glass; (2) sowing spring varieties in a sheltered cage in the autumn; and (3) starting the seed in boxes in gentle heat or in cool frames and planting out. A certain proportion of all the spring varieties sown in the garden last autumn came well through the winter, and flowered very appreciably earlier than the spring-sown plants; those sown in boxes did not transplant particularly well, but with greater experience this method may prove of assistance.

In conclusion a word may be said as to the general arrangement of the gardens. These are three in number, and are used for more or less definite purposes.

The Nurseries.—This is the headquarters garden, and contains the large cage and box culture trenches and also the glass houses, stores, potting shed and a small field laboratory. It is used chiefly for the collection of indigenous plants dug up *in toto*, for the first growing of collected seeds, and for grouping selections.

The Terraces —This is used for small scale nationality and place-of-origin trials and for the first multiplication of selected plants.

The Triangle, which is more sheltered than the other gardens, is intended primarily for hybridization work, for all investigations bearing upon the fertility affinities of the grasses and clovers, and for experiments generally as opposed to pedigree cultures. This garden is also equipped with a small cage.

It is hoped to bring the farmers of the adjoining counties into the closest possible touch with the work of the Station. During the present season, despite the difficulties connected with the harvest, two parties have visited the trial grounds from Montgomeryshire, a large party from Cardiganshire, and a small party from Pembrokeshire, and it may be taken as a hopeful augury for the future that as much interest was shown in the small-scale—from the farmers' point of view one might almost think ridiculously small-scale—trials conducted in the gardens as in the oat variety and other larger and more obvious experiments in the field.

LICENSING OF STALLIONS UNDER THE HORSE BREEDING ACT, 1918; SEASON 1920.

As part of its operations for the improvement of the horse-breeding industry the Ministry introduced in 1911 a scheme for the voluntary registration of stallions with a view to the gradual elimination of unsound stallions in England and Wales. Owners of " Pedigree " sires were invited to submit their stallions for examination by veterinary surgeons appointed by the Ministry, and certificates of soundness for breeding purposes were issued in respect of those stallions that passed the examination. In the year 1911, 313 certificates were issued, and the number increased each year until 1919, the last year of voluntary registration, when 2,334 certificates were granted. The steady increase in the number of stallions registered each year indicated clearly that owners recognised the advantage of having the Ministry's certificates of soundness for their stallions.

With the support of the Horse Breeding Societies, and with a view to protect the owners of registered stallions from the unfair competition of unsound animals, and to give mare owners a larger number of sound sires from which to select, it was decided to go a step further and to require by statute the compulsory licensing or certification of all travelling stallions, pedigree and non-pedigree. The necessary legislation, the Horse Breeding Act, was passed in 1918. Under this Act, and the Horse Breeding (England and Wales) Regulation, 1919, it is illegal for a stallion of two years of age or over to be travelled after 1st January, 1920, for service, or exhibited on premises not in the occupation of the owner of the stallion with a view to its use for service, unless the stallion is at the time licensed under the Act.

It may be of interest to those who are endeavouring to secure improvement in the horse-breeding industry by the elimination of unsound travelling stallions and by other means, to know the results of the first year of operation of the Horse Breeding Act. Up to the close of the past season, 4,153 stallions were examined, and of these 3,749 were licensed by the Ministry. The remainder (404) were refused licences. Of the 3,749 which were licensed, 3,370 were pedigree stallions and 379 were horses not entered or accepted for entry in any recognised Stud

Book. As evidence of the popularity of the Shire it will be seen from the following table that of the 3,370 licensed pedigree stallions no fewer than 2,258 were of that breed, and that 172 of the 379 licensed non-pedigree animals were also of that type.

TABLE I.

Pedigree Stallions, i.e., Stallions entered or accepted for entry in the recognised Stud Book of their Breed.	Heavy.			Light.			Pony.			Totals												
	Breed.			Breed.			Breed.															
	Shire	Clydesdale	Suffolk	Percheron.	Hackney.	Thoroughbred.	Arab.	Hunter	Cleveland Bay.		Yorkshire Coach.	Welsh Roadster.	Welsh.	Polo.	Dales.	Pell.	Shetland	Highland.	New Forest.	Welsh Cob.		
Licensed	2,258	286	138	33	—	202	183	19	9	8	7	3	—	33	21	17	10	1	1	69	—	3,370
Refused ..	262	46	12	1	—	17	10	—	1	—	—	—	—	—	1	—	2	1	—	6	—	369
Applications	2,620	332	205	34	—	219	193	19	10	8	7	3	—	33	22	17	11	1	1	76	—	3,739

Non-Pedigree Stallions, i.e., Stallions not entered or accepted for entry in a recognised Stud Book.	Types.			Types.			Types.			Totals													
	Types.			Types.			Types.																
	Shire.	Clydesdale.	Suffolk.	Percheron	Others	Hackney.	Thoroughbred.	Arab	Hunter.		Cleveland Bay	Yorkshire Coach	Welsh Roadster	Others.	Welsh.	Polo	Dales	Pell.	Shetland.	Highland.	New Forest.	Welsh Cob	Others
Licensed	172	10	4	9	54	41	2	1	5	—	—	4	30	1	—	3	2	—	—	—	20	21	379
Refused ..	23	5	—	—	7	8	—	—	—	—	—	—	4	1	—	—	—	—	—	—	1	1	45
Applications	195	15	4	9	61	44	2	1	5	—	—	4	34	2	—	4	2	—	—	—	21	23	424
Total Licensed	2,430	296	137	42	64	218	185	20	14	8	7	7	30	34	21	20	19	10	1	1	89	21	3,749
Total Refused ..	285	51	12	1	7	20	10	—	1	—	—	—	4	1	1	—	2	1	—	—	7	1	404
Total Applications	2,715	347	209	43	61	263	195	20	15	8	7	7	34	35	22	20	21	11	1	1	96	22	4,163

The following diseases or defects are prescribed in the Regulations as rendering a stallion unsuitable for service of

mares, namely: cataract, roaring, whistling, ringbone (high or low), sidebone, bone spavin, navicular disease, shivering, string-halt and defective genital organs.

The table hereunder gives the number of horses in respect of which licences were refused, and the diseases on account of which they were refused:—

TABLE II.

BREEDS	No examined	No refused	Percentage of refusal	REASONS FOR REFUSAL.											
				Roaring	Whistling	Sidebone	Cataract	Ringbone.	Bone Spavin	Defective Genital Organs	Stringhalt	Shivering	Defective Circulation	General unsoundness	Navicular Disease
Pedigree															
Shire ..	2,520	262	10.4	74	73	57	19	14	4	10	2	5	1	3	.
Clydesdale ..	332	46	13.8	14	10	18	1	8	1	8	1	.	.	.	.
Suffolk ..	205	12	5.9	.	8	2	.	.	1	1	.	.	.	.	.
Percheron ..	84	1	0.8	.	.	1	.	.	.	.	.	.	.	.	.
Hackney ..	119	17	7.8	3	1	3	2	1	2	1	3	.	1	.	.
Thoroughbred ..	198	10	5.2	.	8	.	.	2	3	1	.	.	.	.	1
Hunter ..	10	1	10.0	.	.	.	.	.	1	.	.	.	.	.	.
Polo Pony ..	22	1	4.5	.	.	.	.	.	1	.	.	.	.	.	.
Fell Pony ..	19	2	10.5	.	.	1	.	1	.	.	.	.	.	.	.
Shetland Pony ..	11	1	9.1	.	.	.	1	.	.	.	.	.	.	.	.
Welsh Cob ..	75	6	8.0	1	3	.	.	1	.	1	.	.	.	.	.
Non Pedigree															
Heavy ..	284	35	12.3	9	5	12	.	1	2	1	1	2	2	.	.
Light ..	90	7	7.8	2	.	.	1	1	1	1	.	.	.	.	.
Pony and Cob ..	50	8	6.0	.	.	1	.	.	.	2	.	.	.	.	.
Total of refusals		404		102	101	91	24	22	20	18	8	7	4	9	1

Seventy-seven appeals were made against refusals of licences, and in 27 cases these were successful. The 27 cases are not included in the table.

Attention is drawn to the fact that persons who are in charge of stallions travelling for service are liable to be called upon to produce their licences, and in this connection the provisions of Section 3 (Sub-section 3) of the Act cannot be too widely known. Under that Sub-section a licence granted under the Act or certified copy thereof shall be produced:—

- at the time of or before the service by the stallion of a mare, if so required by the owner or person in charge of the mare, and
- at any time, if so required by an officer of the Ministry or a police officer or any person authorised by regulation under this Act,

and if the person for the time being in charge of or having control of the stallion fails to produce the licence or certified copy when so required he and also the owner of the stallion, if the failure is due to his default, shall be liable on summary conviction to a fine not exceeding £5. The Ministry this year instructed their Inspectors to require the production

of licences for stallions they met on the road and also invited the co-operation of the police in this direction. The necessity for having the licence available for production by the groom did not seem to be generally understood at first, but fewer contraventions in this respect were reported towards the close of the travelling season, and it is hoped that next year owners will not fail to send out the licences with the stallions. The policy of the Ministry this year—the first of the operation of the Horse Breeding Act—has been to warn stallion owners and others of the requirements of the Act, and prosecutions have only been instituted in those cases where deliberate contraventions of the Act have occurred.

It should be added that licences issued for the licensing year 1920 expired on the 31st October, 1920, and should be returned to the Ministry as soon as possible after that date. Failure to comply with this requirement renders an owner liable to a fine not exceeding £5. From the 1st November, 1920, applications may be made for licences for the year ending 31st October, 1921, and as the Ministry cannot undertake to examine stallions at short notice, owners are advised to send in their applications at the earliest possible date. If many defer doing so till the service season approaches it will not be possible to deal with all applications before the season actually commences.

EDUCATION IN POULTRY KEEPING.

PERCY A. FRANCIS,

*Technical Head of the Small Live-Stock Branch, Ministry of
Agriculture and Fisheries.*

THE chief objects of education in poultry keeping are to improve generally the methods practised by persons engaged in the poultry industry, so as to enable them to obtain the best possible financial results from their efforts and to compete successfully with foreign producers.

It is obvious, therefore, that education in poultry keeping must be, as a rule, directly vocational in character, though the importance of developing the student's powers of observation and clear thinking should be borne in mind. Persons who have received a good general education before studying the special problems involved in poultry keeping are undoubtedly in a favourable position to assimilate readily vocational instruction, and can bring to bear trained powers of observation and deduction upon the methods adopted in an industry which is new to them.

In other words, a trained and cultivated mind has always an advantage over the untrained, given equal natural ability at the outset, and thus the possession of a good general education is always of great value to students of poultry keeping, and enables them to attack more easily the various practical, commercial, and scientific problems which arise from time to time in connection with their work.

It is no doubt true that skill in controlling labour, shrewdness in buying and selling, soundness and quickness of judgment on the various points of difficulty—met with in poultry keeping as in every other industry—are, to a large extent, inherent in the characters of successful poultry farmers, or are only acquired as a result of long and sometimes expensive experience. At the same time technical instruction is obviously of great value to the beginner, and is also the means by which the more experienced poultry keepers are kept informed of the results of the work and investigations of others.

Need of Education in Poultry Keeping.—It is well known to those of us who have worked for many years as itinerant poultry instructors how often poultry keepers, living a comparatively short distance apart, know little or nothing of each other's methods, though of recent years the work of poultry

societies, itinerant instructors, and the poultry press has done much to promote interchange of ideas and experience. There is still, however, a wide field for the dissemination of knowledge. How few farmers, for example, have ever seriously studied the lessons to be drawn from the numerous laying trials conducted for many years past in this and in other countries! How many poultry keepers still use and erect poultry houses of uneconomic types and pursue methods of breeding, feeding, and general management which, in the light of up-to-date knowledge, are known to be inefficient!

These are some of the causes which compelled Great Britain last year to pay approximately £35,000,000 to other countries for eggs and poultry, though we know there are, in this country, large quantities of waste food from households, and natural poultry foods on wide areas of land, which could be profitably converted into poultry products if poultry were more generally kept, and kept on efficient methods.

It may be true that we have in this country breeders of poultry whose skill is not excelled in any other part of the world, but it is equally true that the methods practised by many of our poultry keepers leave much to be desired. There are also many beginners every year, probably more this year than ever before, and the continued and extended dissemination of technical knowledge is essential to successful progress.

Poultry Clubs and Societies.—For many years the poultry clubs and societies have been doing valuable work in this direction, but their activities have been limited to some extent by the funds at their disposal. Much of their work, however, is of a voluntary nature, and the industry owes a debt of gratitude to the men and women who have given so freely of their time and energy to this work.

State Assistance.—State-aided poultry instruction has also been provided for many years in this country, partly in direct form, but mainly through local authorities and educational institutions. The majority of the county councils in England and Wales now employ whole or part-time poultry instructors of either sex, the expenditure involved being met usually from a joint fund made up as to one-third from the local rates and as to two-thirds by a grant from the Ministry of Agriculture.

In a number of counties the instructor acts as both dairy and poultry instructor, though this combination of duties is not desirable, since pressure of seasonal work in both is to a large extent simultaneous, and one or both branches are liable

to suffer. The financial economy derived from such an arrangement is, therefore, of doubtful value, especially in view of the urgent need of building up the British poultry industry before foreign competitors produce again exportable surplusses to the same extent as in pre-war days.

At the present time there are 57 whole or part-time itinerant poultry instructors employed in England and Wales. In a few counties it has been found necessary to appoint assistant poultry instructors, as, for example, in Yorkshire, where there is an increasing demand for instruction from industrial areas. There are, however, eight counties which employ no poultry instructor, *i.e.*, Bedfordshire, Cambridgeshire, Isle of Ely, Huntingdon, Isle of Wight, Norfolk, Somersetshire, and Soke of Peterborough.

Owing to the extension of poultry keeping in industrial areas and the increasing demand for instruction manifested in some of the county boroughs, the Hull County Borough Council have informed the Ministry that they desire to set up a scheme for the provision of instruction in poultry keeping which would include the provision of an egg-distributing centre, and have inquired whether a grant could be made as in the case of county education authorities. This is the first case of a county borough desiring to inaugurate a scheme apart from the county scheme. Owing to the size of the population and the large number of allotments, the borough council consider there is sufficient work for a whole-time poultry instructor.

In addition to provision made for itinerant instruction by county councils, poultry instructors are also employed by some 20 or more agricultural colleges, farm institutes, and farm schools, most of which receive grants from the Ministry for their general agricultural work, including instruction in poultry keeping. In several instances these institutional instructors also do a certain amount of itinerant work in the adjoining counties.

Importance of Co-ordination and Co-operation.— It is desirable that in future these various educational activities should be more closely co-ordinated and organised on more efficient lines, and that there should be more effective co-operation between local authorities and the local poultry societies and clubs. This co-operation ought not to be difficult of achievement if the societies would show active interest in the work of their county councils and educational institutions, and would endeavour to obtain representation on the committee of the

council which is charged with the supervision of the county poultry schemes.

There is no reason why representation for local poultry keepers' interests should not be obtained in this way, and societies and clubs would then have a direct voice in the administration of county council poultry schemes, and much more efficient co-operation between State-aided and voluntary effort would be possible. In too many instances in the past the county poultry instructor has been doing isolated and comparatively unknown work with little public support. Let the societies and clubs see that this is changed; that the county councils, colleges, and their instructors are given the fullest measure of support and assistance, and that thereby the greatest possible efficiency is obtained in carrying out the schemes for which only a very limited amount of public money is available.

The societies and clubs can help in so many ways—by suggesting centres for lectures, classes, and the establishment of egg-and-chick-distributing centres; by keeping their members informed as to lectures, &c., and the dates when the county instructor is expected to visit the various districts; by distributing leaflets and bulletins; and by generally assisting the instructor to perform his many duties efficiently and without undue delay.

Various Needs to be Met.—The problem of providing suitable forms of education in poultry keeping to meet the needs of all is not an easy one. There are those who cannot spare more time from their work than is occupied in attending an occasional public lecture, and persons of this type may be country, urban, or city dwellers. There are the sons and daughters of farmers and small holders who will be occupied ultimately, as a rule, in poultry keeping as a branch of agriculture or horticulture. Others may desire instruction to enable them to make poultry keeping their main source of livelihood; and, finally, there are those who desire a complete scientific and practical training to equip them as qualified teachers of poultry keeping.

Itinerant Instruction.—For the mass of poultry keepers all the evidence available in this and other countries goes to show that itinerant instruction by competent instructors is by far the most effective form of education. This includes lectures, visits to poultry keepers in their homes, and peripatetic classes.

Public lectures usually constitute the preliminary stages of itinerant instruction, and though the actual teaching value of these lectures is necessarily somewhat circumscribed, they serve to arouse interest, and have been the means of creating large numbers of new poultry keepers, and assisting many others. Visits by the instructor, if properly carried out, probably constitute the most effective method of conveying information to those who are the producers at the moment and who do not, for various reasons, attend lectures or classes, nor, to any extent, read poultry papers.

When the itinerant instructor has gained the confidence and respect of these people, he can be of help to them in many ways. He is able to advise them on the spot in a manner suitable to their particular circumstances and aims. He can give help not only in purely technical matters—and in a young industry, where improved methods are frequently being evolved, it is important that knowledge of these should be spread as quickly and widely as possible—but he can often give valuable advice as to marketing produce and purchasing feeding stuffs, appliances, &c. It is astonishing how often poultry keepers buy their requirements in the dearest markets and sell their produce in the cheapest.

Itinerant lectures and visits are still the basis of instruction in most counties, but in order to meet the increasing demand for more systematic instruction a few counties have commenced peripatetic classes for younger people who can only leave their homes or employment for a few hours daily. These classes, which are held for short periods of three or four weeks at various centres, provide not only theoretical teaching, but also practical instruction in artificial and natural methods of hatching and rearing; testing, grading and packing poultry produce; killing, plucking and trussing poultry; construction of simple appliances, &c. The courses are usually held daily at hours suitable to the seasonal work of the district, and at the end of the course the equipment is moved to a fresh centre, so that the instruction is conveyed, in time, over the whole county. Thus, in Shropshire, for the year ended 31st March last, the poultry instructress, in addition to her other duties, conducted six four-week courses at various centres, at which an average of eight pupils attended right through. It is obvious that if those pupils, as is probable, put into practice at home the information gained at the classes, they will not only benefit themselves, but they will also

exercise a good influence over other poultry keepers who may live near them.

Schools of Instruction.—Then, as distinct from itinerant instruction, regular courses are provided at the farm institutes and farm schools, which have been set up in some counties and are under consideration for many others. A number of these will be in operation during the next 18 months. At these institutes or farm schools, which are intended to provide instruction on a lower plane than that of an agricultural college, young men and women of 16 and upwards are instructed in the various subjects of rural economy, including poultry keeping. Poultry stock and plant on modern lines usually form part of the educational equipment, and regular instruction is provided. Students take part in the routine practical work, and thus become familiar with the various appliances in use, and with the points and economic qualities of the breeds maintained. Thus, at the Farm School, Newton Rigg, Cumberland, 64 pupils received general instruction in poultry keeping last year.

Higher Education at Colleges.—Finally, the provincial agricultural colleges, in addition to providing instruction in poultry keeping to their agricultural and dairying students, provide also, in some cases, special courses in poultry keeping for students who desire to obtain a more specialised knowledge of the subject, *e.g.*, the Harper-Adams College provides special courses extending over one session of three terms. These courses include instruction in anatomy, physiology, and diseases of poultry, natural and artificial incubation and brooding, foods, feeding, and general management, parasites, and the various enemies of poultry, water-fowl, and turkeys, book-keeping and carpentry. Lectures are also provided on elementary agriculture and on the economic relationship between poultry keeping on the one hand and agriculture, horticulture, and market gardening on the other. Practical work is provided for the students on the college poultry plant. Demonstrations are given in connection with the college laying trials, and visits are paid to well-managed poultry farms within easy reach of the college.

Possibilities of Extension of Poultry Education.—From the foregoing it will be gathered that considerable provision for instruction in poultry keeping is already made in this country, and there is no doubt as to the beneficial effect which has

accrued from this work. There is, however, considerable room for further extension, especially as regards higher instruction for those who desire to become teachers of poultry keeping. This is an age of specialisation, and when regard is had to the amount of educational, investigational, and research work carried on in connection with the poultry keeping industry in America it is obvious, particularly in regard to investigation and research, that much more requires to be done in this country if home production is to be substantially increased and future foreign competition successfully met.

Unlike agriculture, the poultry industry, regarded as a commercial venture, is of comparatively recent growth. Methods are far from being perfected or standardised, and the comparative values of different practices in feeding, housing, and general management require investigation. Our knowledge as to the best methods of combining poultry keeping with either horticulture, market gardening, or agriculture, is still limited. The efficiency of present methods of artificial hatching and rearing leaves much to be desired; whilst our knowledge of poultry diseases and their prevention is still very imperfect.

The poultry institute, which it is hoped may be established before long, will have a wide sphere of work, much of which will be on virgin soil so far as this country is concerned, and should prove of immense value to all poultry keepers. The poultry industry means more to this country than many people imagine. No definite figures are available as to the quantity or value of the poultry and eggs produced annually in Great Britain, but it is practically certain that poultry produce to the value of well over 50 millions sterling was consumed in this country last year, though, unfortunately, Great Britain paid 35 millions of this sum to other countries.

When it is remembered that poultry keeping offers a profitable spare time occupation to many classes of people, that poultry can be kept in a large degree as an added crop on the land, and that under proper management they can be fed to a considerable extent on waste materials and by-products, it will be realised that the possibilities of expanding home production are very great. There is also no doubt that home-produced poultry and eggs are infinitely better for the health of the nation than imported frozen poultry, and preserved dried or liquid eggs from China.

PROFITABLE PEARS FOR MARKET.

IN successful pear-growing, great care is required in selection of varieties suitable both for the locality and the class of trade to be supplied. Mistakes in this direction are easily made from failure to appreciate the difference between garden and plantation conditions. The object of this article is to point out both the good and bad points of the varieties commonly grown, and to assist the grower generally in choosing those most suitable for the purpose he has in view.

In many parts of the country where the climate is mild, the growing of pears under plantation conditions, either as "fillers" or in blocks, is a paying investment. The area devoted to this class of fruit is on the increase, but the demand for good quality pears, especially from October to December, is very great, and there is room for a considerable increase in production.

Factors influencing the Choice of Varieties.—(1) *Marketing.*—The quality of different pears varies very considerably, but the very high-quality kinds do not as a rule prove the most profitable commercially, as they are generally shy croppers. It is unfortunate that there are few varieties combining the characteristics of high quality and fruitfulness together with hardiness, and in selecting varieties one is often obliged to sacrifice quality in order to obtain a paying quantity. Roughly the chief pear varieties may be divided into three classes:—

- (a) Very high quality pears, shy in bearing and requiring exceptionally favourable conditions. The culture of these in this country is almost entirely confined to private gardens, where quality is of prime importance and monetary return a secondary consideration. A small part of the trade is supplied from home sources and the bulk comes from abroad.
- (b) Medium quality kinds which crop well and thrive over a fairly wide range of soil and climatic conditions. These are the varieties chiefly grown for market in the southern fruit districts, and are suitable for the general retail trade. Taken as a whole, they usually bring very fair returns.
- (c) Poor quality early pears, very ~~hardy~~ and usually heavy cropping. These usually are sold for the cheap retail, coster and seaside trades. On account of their earliness and their heavy ~~crops~~ they are often very profitable in

spite of the poor quality. This is especially the case where growers are near seaside towns and can supply the retail trade direct.

A succession of varieties should be selected, so that picking and marketing are spread over as long a period as possible, and—in the case of the grower who sells direct to retailers—a continuous supply should be maintained.

(2) *Method of Cultivation*.—Standard and half-standard trees which are grafted on pear stocks are not generally recommended. They are so slow in bearing that often a profitable crop is not obtained until 20 years have elapsed after planting, and the fruit from this form of tree is not of such good quality as that from bushes or cordons, owing to the greater attention which the latter receive.

Bush pears on quince stock are preferable, for their habit of growth is generally upright and the trees come into bearing a very few years after planting. As "fillers" they are ideal, as they are somewhat short-lived and are usually past their prime by the time their removal is necessary. Unlike many apples, pears crop well on a system of close spur pruning and restrictions, and they are, therefore, particularly suitable for cordons. This system entails a high cost of production, and should only be adopted for the best of the commercial varieties, where locality and situation are favourable, on suitable land in good heart, and when it is quite certain that the trees will receive the necessary amount of attention.

(3) *Locality and Soils*.—Pear growing—especially of high quality varieties—is mostly confined to districts with a mild climate, and for this reason the South Western Counties and many districts with suitable soils bordering on the English Channel are particularly suitable.

Pears worked on Quince require particular soil conditions, but as a general rule it can be taken that in their likes and dislikes they follow closely apples worked on the weaker types of Paradise. The ideal soil is a sandy retentive loam with good natural drainage; brickearth with a slight mixture of sand is particularly suitable. They require good land and do not thrive on extreme types of soil such as cold wet clays or thin soils on chalk or gravel, but there is a wide range between these on which they can be profitably grown. Local information as to the suitability of a district and the soils therein can usually be obtained and should be given due consideration, especially in relation to the fruitfulness of a variety and its power to resist disease.

Description of Market Varieties of Pears.

<i>Variety and Season.</i>	<i>Description.</i>
BEURRE CLAIRGEAU Nov.	Culinary. Large, lemon yellow tinged with orange red. Strong and upright grower. Said to bear profitably in the North.
BEURRE DE CAPIAUMONT Oct.	Dessert, medium quality. Medium size, pale yellow covered with russet tinged with red. Succeeds in the North.
CAILLOT ROSAT Aug.	Dessert, good quality. Medium size. Greenish yellow with brownish red cheek streaked with red. An excellent bearer where at home, as it is said to be in the North.
CHALK (CRAWFORD) Aug.	Poor quality dessert, but fairly regular cropper. Often planted as a standard for a windbreak. Too many should not be planted, as it must be marketed just before it is ripe.
CONFERENCE ... Oct.—Nov.	Dessert of good quality. Medium size, and very long necked, yellowish green, much russeted. Growth upright and strong in good soils, but should be grown on pear stock on poorer land. Owing to its regular and heavy cropping powers a popular and reliable market variety.
CLAPP'S FAVOURITE Mid. Aug.—Sept.	Dessert, of good quality, but becomes mealy if kept too long or allowed to ripen completely on the tree. Medium size, shape uneven. Bright yellow with bronze or crimson cheek and deep crimson stripes. Growth moderately strong and upright. Crops well, and is a valuable market variety. Responds to double working.
CATILLAC ... Dec.—April.	Culinary, good quality. Large, dull green with brown red flush. Growth strong and spreading, somewhat pendulous. A hardy and useful variety, but a little uncertain on some soils.
Dr. JULES GUYOT Early Sept.	Dessert, very similar to Williams in appearance and quality, but must not be allowed to ripen on the tree, and does not keep long. Large, lemon yellow with black dots and generally a red cheek. Regular cropper. Growth weak and compact. Responds well to double working.
DOYENNE DU COMICE Nov.	The finest and highest priced dessert pear grown. It frequently fails to crop well. Should only be planted experimentally at first.
DURONDEAU Oct.—Nov.	Dessert, good quality. Large, a deep russet brown with a crimson flush. A regular and free cropper. Growth strong and upright. A good market variety.
EMILE d'HEYST Oct—Nov.	A valuable dessert variety of very good quality. Light yellow with patches of russet. A fairly good cropper, but not reliable in all situations. Moderate and irregular growth.
FERTILITY ... Oct.	Fair quality dessert. Medium size, russet with an orange tinged cheek. Regular and heavy bearer. Growth moderate and upright. Makes an excellent bush. Should be grown on pear stock on the poorer soils. Has immense cropping powers. Liable to canker.

<i>Variety and Season.</i>	<i>Description.</i>
HAZEL OR HESSLE Oct.	One of the most profitable of the small pears; a very heavy cropper and vigorous grower. Especially useful where more tender varieties will not succeed.
LAMMAS Aug.	May be described in the same terms as Hazel, but too many should not be planted as it must be marketed as soon as ready. A long time coming into bearing.
LOUISE BONNE OF JERSEY Oct.	A dessert pear of high quality and somewhat unusual flavour. Medium size; yellowish green with a dark red cheek. Growth medium and upright. A very valuable variety in a congenial situation, when it is a heavy and regular bearer, but in other situations is liable to suffer from frost.
MARGUERITE MARILLAT Sept	A dessert pear of quite good quality. Very large; orange yellow with red flush and patches of russet. Growth strong and upright. Bears freely in a warm and sheltered situation.
MARIE LOUISE d'UCCLE Oct.	Large dessert of quite good quality if not left too long on the tree, but does not keep long. Skin marked with pale cinnamon russet. Tree of good growth and shape. Generally a very heavy cropper, but care should be taken to market before ripe.
MOOR FOWL'S EGG (Muirfowl's Egg) Oct.	An old Scotch dessert pear of fair quality, and rather below medium size. Yellowish green, with a mottled red cheek and covered with pale russet dots. A reliable cropper and vigorous grower; is hardy in Scotland and the North country.

(This article is also issued as Leaflet No. 347)

LAND DRAINAGE.

The Improvement of Watercourses.—The Land Drainage (Ouse) Provisional Order Act, which has now become law, is a measure of great importance, and is one of the first concrete results of the passing of the Land Drainage Act in 1918.

In all low-lying districts the prosperity of agriculture depends essentially upon the maintenance of the main water-courses in such a condition that floods can be controlled to the greatest possible extent, and flood-water prevented from lying on the land long enough to impair its fertility.

The present condition of most of the great rivers in England is lamentable, and it has arisen in almost every case from the absence of a Central Authority possessing the power to control the whole river and to hold a fair balance between conflicting interests. The Ministry has long felt that the Great Ouse is a case where the need for such an Authority is the most urgent. It was clear from the beginning that, owing to the number of important local Drainage Authorities—some of them upwards of 300 years old—which already existed to look after local interests, and to the number of divergent interests which had to be safeguarded, the establishment of a Central Authority for the Great Ouse would present very serious difficulties. At the same time, it was thought that if the soundness of the Ministry's policy could be established in such a case, an example would be set which could hardly fail to be followed on the other great river systems throughout the country.

The Ouse Provisional Order was settled by the Ministry with the loyal help of the majority of the drainage and other Local Authorities concerned, but was very strenuously opposed by a small minority of Authorities and individuals. This opposition led to a debate in the House of Commons, and to a most exhaustive discussion before Committees of both Houses of Parliament. The result has been that the policy of placing the whole of each river system under a Central Authority, responsible for all sections of the main channels, has been completely vindicated. The principles embodied in the Ouse Provisional Order were upheld in their entirety by Parliament, and the alterations made by the Committees were in matters of detail only, and were all made, with one exception, either at the instance or with the consent of the Ministry.

Besides the main principle of policy already referred to, certain

other vital principles of general application were discussed and upheld by the Parliamentary Committees. The two most important are the following :—

(1) *No Taxation without Benefit*.—The general law does not permit of the rating, for the maintenance of a river, of the whole of the high lands within the watershed. Only such lands as may suffer from the bad condition of some part of the river can be taxed. Whether any alteration of this law is desirable or not, both Committees held strongly that the establishment of Drainage Authorities is a matter which should not be delayed upon any pretext.

(2) *No Benefit without Taxation*.—Wherever land is benefited by drainage works, it is proper that it should contribute to the carriage, right down to the sea, of the water from which it is freed by those works. This principle was discussed at very great length before both Parliamentary Committees, and was emphatically endorsed by them. The Committees also upheld the contention that the benefit derived from the maintenance of main channels is not confined to “land liable to flooding.”

Of the principles, which are embodied in the Ouse Act and which were not disputed before Parliament, the most important are (1) that there should be no qualification for voting at Drainage Board elections except the owning or occupying of lands in the district and the payment of all rates due; (2) that membership of the Drainage Board should be open to all owners of not less than 10 acres and to all occupiers of not less than 20 acres within the district; and (3) that the Drainage Board and the County Councils should be kept in close touch with one another, by a small proportion of members of the Drainage Board nominated by the County Councils.

It is essential for the welfare of agriculture that in setting up Drainage Authorities the river should be regarded as the unit of administration, regardless of the fact that it may flow through a number of counties. In many cases a river is itself the boundary between counties, or is crossed and recrossed by the county boundary in many places. In all such cases it is obvious that the county boundary must be disregarded, and the problem must be viewed as if counties, as such, did not exist. Indeed, there is only one case in England—the Yorkshire Ouse—of a great river being in one county only, and even there, owing to the administrative division of the county into Ridings, false issues are raised and differences of a non-essential nature appear at first sight as serious difficulties.

Having obtained, by the passing of the Ouse Drainage Order into law, the establishment of so important a principle, it would hardly be possible for the Ministry to stand still in its task. The improvement of the Yorkshire Ouse and Derwent, and the plains through which those rivers flow, is an equally pressing work which is receiving the attention of the Ministry. A measure creating a Drainage Board for that purpose is already under discussion, and it is hoped that before long all those who are interested in the improvement of agricultural conditions in Yorkshire will have full opportunities of considering its provisions. It is also to be hoped that those provisions will command such a measure of general assent, in the light of the recent discussion of the Ouse Bill, that no further reference to Parliament will be necessary.

It must be plain to all who will consider the question impartially that if farming in the low-lying districts of England (which are also the most fertile) is to prosper as it should, some active and immediate measures must be taken to improve the condition of the rivers. No such measures are possible without full co-operation, and a certain amount of "give and take," between the various interests in the drainage area of the whole river.

The Powers and Conditions of Drainage Boards.—The powers of Drainage Boards cannot be better summarised than in the words of the Land Drainage Act of 1861, which lays down that they extend to the following undertakings:—

- (1) "To cleansing, repairing or otherwise maintaining in
"a state of efficiency any existing watercourse, out-
"fall, or defence against water;"

This is called technically "The maintenance of existing works."

- (2) "To deepening, widening, straightening, or otherwise
"improving any existing watercourse or outfall,
"removing weirs or other obstructions, or raising or
"altering any defence against water."

This is called technically "Improvement of existing works."

- (3) "To making any new watercourse, outfall, or defence
"against water, or erecting pumping or other
"machinery."

This is called technically "the construction of new works."

All these powers are subject to various restrictions for the protection of property and other interests, and new works or improvements of existing works can only be carried out after due notice has been published and opportunities given for ratepayers to object. Any such works which would cost over £1,000, or over £1 per acre of the lands which would be rated for them, can be vetoed by the objections of the owners of one half of such lands.

To pay for the expenses incurred by a Drainage Board, the Board levies rates on all lands in its district which derive any degree of benefit from its works. Rates for "maintenance" are levied on occupiers, and rates for "new works" or "improvements" fall upon owners. Payment for "new works" or "improvements" is frequently spread over a period not exceeding thirty years.

No rates can be levied on lands which derive no benefit from the Board's operations, but as there are limits to the amount of sub-division which can be made, it is usual to "pool" expenses to a considerable extent.

The only kind of Drainage Authority which can be established by the Ministry of Agriculture is that known as an "Elected Drainage Board."

The first members of the Drainage Board are obliged by statute to be named in the Order which establishes the Board. They only remain in office, however, until an election can be held, which is usually from twelve to eighteen months after the date of the Order. During that time they are mainly engaged in preparing the rate-books and registers of electors, determining the staff required, and beginning such work as may be obviously necessary and urgent. When the first members retire, at least a majority—usually about two-thirds—of the members must be directly elected by the ratepayers (owners and occupiers) in the several areas which they represent. Thus the policy of the Drainage Board depends upon the views of the electors. A small number of members are appointed by County Councils or other authorities or corporations, who have special interest, and with which it is desirable that the Drainage Board should keep in close touch.

It has frequently happened that inquiries have been held as to the steps which should be taken to put some river into perfect order, and as to the cost which would be involved. Distinguished engineers have elaborated schemes of works, usually involving very heavy expenditure, and nothing further

has been heard of the matter for many years. It is sometimes thought that the Ministry, in endeavouring to establish a Drainage Board, is conspiring to force the carrying out of one or other of these elaborate engineering schemes, and that on the establishment of such a board the district will suddenly be burdened with intolerable expense. It must be stated with the greatest emphasis that this is not the case. A Drainage Board at the outset of its career is faced with the heavy task of preparing the way for its successors, and must necessarily feel its way slowly in the matter of works. Its ultimate policy and the amount of money it spends will depend (as has already been pointed out) upon its electors. So long as a board makes reasonable use of its powers it is subject to no outside interference from any quarter. The object of the Ministry is to establish on each river system an authority which will view the problems presented by the whole system as a whole, and will have legal powers to deal with them.

THE DORSET ARTS AND CRAFTS ASSOCIATION:

A SUSTAINED AND SUCCESSFUL EFFORT.

MISS M. B. MANSEL,
Secretary to the Association.

THE Dorset Arts and Crafts Association was started in 1905, with the object of encouraging handicrafts work in the county. An Executive Committee was formed, and lists of articles, the manufacture of which it was intended to promote, were drawn up. These were adapted from those in use by the Wiltshire and Somerset Associations, which had been in existence for some years. From the first there was no doubt of the popularity of the movement. Exhibits of all kinds and qualities poured in, the result of many years work of "home industry." It was considered desirable at the commencement not to be too drastic in disqualifying any exhibit, and so possibly damping the enthusiasm of an exhibitor, but rather to encourage every kind of effort until the exhibitors gradually learnt the type of article which would be most useful and likely to command a sale. Exhibitions are held annually in the county, and inferior work has dropped out, in consequence, and the exhibits have become less numerous, but the quality and workmanship have improved.

In the early days of the movement there were not many organised classes in the villages, and only a few in the towns, but, with the assistance of grants from the Association to meet the initial expense of starting classes, and to cover such incidental expenses as material, tools, lighting and heating, and the holding of the annual Exhibition, instruction is now being given on a large scale, and much pleasant and profitable employment is provided. Basket, leather and metal work, and ornamental and useful needlecraft classes were organised in the villages and small towns, and in a short time were working well and soon became self-supporting.

Class work and co-operation among the members are essential to the success of an Association. A number of exhibits of the same kind from one class promotes competition, and results in the work being more skilfully executed. A class will soon acquire a reputation for good work, and if reliance can be placed on the goods made, orders for large quantities may be received. When several members of one class work together

production is increased in greater proportion. Individual contributions to any section of the schedule of articles are admitted from any resident in the county (residence is the only qualification), and much that is beautiful is sent. Professional industries also have their place, and serve to advertise work done in the county; pottery, gloves and, occasionally, toys being conspicuous exhibits.

At first the various awards in the section were competitive, first and second-class certificates being offered, but it was found that this system was impracticable when there was a large number of exhibits. The Association therefore adopted the Home Arts Association's principle of merely awarding a certificate of merit to articles which attained a certain standard. A high standard was required, but when it was not quite reached "commended" cards were allowed occasionally, where the judges considered that some recognition was deserved. It is a condition of the Association that no member is eligible to teach in the industry she wishes to take up unless she gained an award at an Exhibition.

At the outbreak of war, several of the boys' and men's classes were necessarily suspended, and difficulty has been experienced in resuming them, owing to the large increase in cost of raw material. In time, however, it is hoped that some of the difficulties may be overcome. The birth of the "Women's Institute" movement* during the War provided a fresh outlet for co-operative work, the objects of these Institutes being to a certain extent similar to those of the Arts and Crafts Association. They have their own "instructors" in the various forms of handicraft, and have sent much good work to the Dorset Arts and Crafts Exhibition; chiefly toys, rush work and gloves. The qualification of the Instructors consists in their work having received distinctive notice from the judges at the Arts and Crafts Exhibition.

By means of the annual Exhibition members are able to see the result of the year's work. Different centres are chosen every year, so as to stimulate local interest as much as possible. The Exhibitions have been held for fourteen consecutive years since the inception of the Association, and during the War a special "Red Cross" stall was included, containing the work of wounded soldiers. In 1917 Her Majesty the Queen presented an "American home canner" to the Dorset Arts and Crafts

*Notes on Women's Institutes have appeared in this *Journal*, January, 1917, p. 966, October, 1918, p. 827, December, 1919, p. 989, and June, 1920, p. 206.

Association as a token of her appreciation of work carried on in difficult times.

Each succeeding year the Association has grown in its usefulness to the county. Many of the handicrafts travel far, even to America and Canada, while awards have been gained at the Home Arts Association's Exhibition in London and at other centres. The joy of creation is becoming a real stimulus in the minds of the workers, who take a delight in producing a new toy or in designing a fresh pattern, and eagerly look forward to the judges' "reports" upon the meritorious articles. To advertise the dignity of labour and self-help and to encourage neatness in execution are the aims of the Association, and each year shows considerable advance in this direction. The happiness of those who produce and also of those who work with and for them has a moral influence which all must feel who are really interested in what concerns the good of others, and what certainly contributes to the prosperity of a Nation.

INSECT AND FUNGUS PESTS DURING THE WINTER:

THE IMPORTANCE OF PLANT HYGIENE.

GEO. C. GOUGH, A.R.C.Sc.,

Horticultural Inspector, Ministry of Agriculture and Fisheries.

WITH very few exceptions, such as the winter moths, one species or another of which is in evidence about this time in the adult moth stage, pests are in a dormant or semi-dormant condition during the winter months. Many of these pests are to be found among the refuse of the crops, and it is therefore essential that the grower should be hygienic in his methods. Plant hygiene or sanitation is increasingly necessary in these days of high cost of labour, and growers are recognising that it is in the end more economical to spend money on improving hygienic methods and so kill a smaller number of parasites while in a dormant condition than to delay action in the hope that the pests may be effectively removed later.

Fungus Pests.—A large number of the pests are associated with the soil, and, more especially the fungus spores, are extremely difficult to kill. In the case of some, such as those causing Wart Disease of potatoes, no practical method of killing by treatment of the soil has been discovered. Another potato disease, Corky Scab, is also perpetuated by infected soil, and no varieties of potatoes are known to be immune from the disease. In the latter case, however, there is good reason to believe that the disease is due largely to wet soils and that drainage may be a remedy, while it is possible that investigations may reveal a chemical which will prove an effective fungicide. Another very common soil pest is Club Root (or Finger-and-Toe) of turnips and cabbages. On many soils this disease may be kept in check by liming, as the fungus propagates itself best on acid soils. In most instances a heavy dressing of lime is needed, even up to 4 tons per acre. Curiously enough, the fungus causing Corky Scab requires the opposite conditions, the disease being more evident in limy soils.

Insect Pests.—Animal pests in the soil are most effectively controlled by working the land frequently so as to give the birds every opportunity of discovering the insects. It has been noted that grease bands on trees on arable land have caught fewer moths than those on trees growing in grass.

The idea of ridging up the land in winter to allow frost to kill insect pests, although excellent from a cultural standpoint, does not seem to stand the test of experience, for insect pests, even when in a dormant condition, can apparently endure the frost, while many fungus spores germinate better after being frozen. Soil fumigants containing a basis of naphthaline are far from being successful generally, although they may enable a crop to become established and so to withstand injury.

Infected Crops should be Removed.—Growers, whether on a large or small scale, should realise that vegetables such as turnips, potatoes, and mangolds which have suffered from fungus disease contain thousands of spores, and it is important that these crops should not be left about to rot or be fed unboiled to animals, as in both cases the spores are by such means returned to the land. Stubble frequently contains the pupæ of flies from the preceding crop. To destroy the pests the stubble should be ploughed in very deeply, or preferably burnt, even though extra trouble may be involved.

Weeds.—Weeds should not be overlooked in this connection. Grasses and weeds on the headlands and weeds in the field are constantly the alternate hosts of pests which would otherwise starve in the interval between the crops.

Fruit and Garden Pests.—The need for the adoption of sanitary methods is perhaps more important to the fruit grower, commercial gardener and allotment holder than to the farmer, since a large number of fruit and garden pests, both insect and fungus, hibernate on the refuse. The refuse heap and manure heap are equally the resort of these parasites, and become a hotbed of disease. A long list might be made of pests of garden crops which could be found in most heaps of unburnt refuse and which will ultimately find their way to the new crop, unless destroyed.

The refuse of the fruit grower largely takes the form of dead wood, although diseased leaves and fruit are common. Except in cases of high wind, fruit which falls prematurely is usually diseased, and should be gathered and burnt or fed to pigs. Very few fruits bear fungus spores which are not destroyed by passing through animals, so that the danger of infecting manure is very slight. Insect pests are readily destroyed, and where possible, fowls should be allowed the run of the orchards, as they are fond of insects and prevent many caterpillars and other larvæ from entering the soil to pupate.

Many leaf spots and other leaf diseases which cause premature loss of foliage are carried through the winter by the fallen leaves. Such leaves should be raked up and burnt.

The pruning of trees and bushes is usually undertaken for the purpose of shaping the growth and allowing light and air to penetrate the foliage, but where the operation is done properly the spread of disease is effectively checked. Wounds, however, should be treated antiseptically to prevent further disease. It is now known that reinfection in several fruit and leaf diseases, such as Brown Rot of plums and apples and Apple and Pear Scab, takes place from infected twigs and spurs, as well as from "mummied" fruit, so that these should be carefully cut away. Dead wood should be removed from plum trees, as Silver Leaf is often caused by such remaining on the tree. *Stereum pupureum*, which causes the disease, only produces its spores after the wood has been killed. It is for this reason, and also because dead wood on a tree is useless and a danger, that the Ministry's Order compelling the removal of dead wood from plum trees before the 1st April of each year was made. It is important that the dead and diseased wood removed should be burnt, as many of the destructive fungi continue to develop after the wood has been removed from the tree. Before the Silver Leaf Order came into operation piles of wood, and even posts and fences, could commonly be seen, on which the causal fungus was breeding and reinfecting hitherto clean trees.

Spraying.—Spraying is an effective means of controlling the ravages of pests. A normal winter spray usually has as its basis caustic soda. A caustic soda spray will remove lichen, moss and other parasites on the bark of trees which serve as a place of refuge for insect pests. A solution of copper sulphate is sometimes used to kill fungus spores. Lime-sulphur solution has the merit of being a cleansing agent as well as a fungicide, and is much in favour at the present time. This spray can also, if necessary, be used every year without injuring the bark, whereas the use annually of a wash made of caustic soda has an injurious effect on the trees.

Spraying should be done after pruning, although not necessarily immediately afterwards. The best results are obtained when the operation is deferred as late as possible. It is commonly stated that the solution should be applied "before the buds swell," but in practice it is better to wait until the buds have swollen, or even after they have commenced to open,

although a slight scorching of the edges of any exposed leaf may follow. The reason appears to be that the eggs of insects or resting spores are but little affected by the wash. The pests are most vulnerable and are easily killed. The best results are obtained when the spores have germinated or the eggs have hatched, which is usually about February.

Lime spraying done late is often effective, and not only cleans the trees but, when properly done, encases insect eggs and so prevents hatching. Even when hatching takes place the insects have difficulty in moving about in the particles of lime.

In conclusion, attention should be paid to the general health of trees. Too little care is given to the roots of trees, although the branches may be well attended to. Many growers appreciate the fact that the leaves breathe and must have light and air to do their work properly, but few realise that the roots also respire and cannot function properly unless the soil is well drained and kept open, so as to allow the air to circulate between the particles of soil. It has sometimes been held in the past that old-established trees require no manure, but it is now recognised that a tree cannot do its best unless it is supplied from time to time with sufficient food which the manure supplies. In this connection it should be remembered that plums in particular require lime, and that probably other fruits need similar special constituents, although little is known at present as to the requirements of particular plants.

FEEDING STUFFS IN NOVEMBER.

PROFESSOR T. B. WOOD, C.B.E., M.A., F.R.S.,
Animal Nutrition Institute, Cambridge University.

THERE is a slight downward tendency in prices since last month, and reports at the present time seem to indicate the probability of an appreciable fall in the price of many commodities, which may extend to feeding stuffs. Some feeding stuffs have advanced in price, notably palm kernel cake, which is, however, still cheap as compared with other materials.

Several correspondents have asked for particulars of the prices quoted in these notes. These prices are quoted from the Weekly Return of Market Prices issued by the Ministry of Agriculture. They represent prices at which actual wholesale transactions have taken place on the larger markets, usually London, and refer to the price ex mill or store. They are as a rule considerably lower than the prices on local country markets, the difference being due to carriage and dealer's commission.

Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £15 per ton. Its manurial value is £2 1s. per ton. The food value per ton is therefore £12 19s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 8s. 6d. Dividing this again by 22.4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1.88d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

At the request of another correspondent particulars of the relative food value and prices of potatoes, swedes and mangolds have been added to the table. The figures given have been worked out backwards from the assumption that the starch equivalent of these foods is worth about the same as that of starchy foods such as maize, namely, 2d. per lb. The figures show that with maize at its present price, the value of potatoes for feeding is about £4 17s. per ton, and of swedes or mangolds about £1 10s. per ton.

Potatoes being very starchy in composition are quite suitable for replacing maize meal or other cereal products. Since the starch equivalent of potatoes is 18 and that of most cereal meals about 70, the replacement should be made in the proportion of 4 parts of potatoes for 1 part of meal.

NOTE.—Beginning with the December issue of this *Journal* the notes on Feeding Stuffs will no longer be written by Professor Wood, but will be prepared in the Intelligence Department of the Ministry.

NAME.	Price per Qr.		Price per Ton.		Manurial Value per Ton		Food Value per Ton		Starch Equiv. per 100 lb.		Price per Unit Starch Equiv.		Price per lb. Starch Equiv.	
	s.	lb.	£	s.	£	s.	£	s.	s.	d.	s.	d.	s.	d.
Barley, English Feeding	78/-	400	21	15	1	6	20	9	71	5/10			3.14	
" Foreign	75/-	400	21	0	1	6	19	14	71	5/7			3.00	
Oats, English	57/-	336	19	0	1	9	17	11	59.5	6/0			3.22	
" Foreign	54/-	320	18	15	1	9	17	6	59.5	5/10			3.11	
Maize	75/-	480	17	10	1	5	16	5	81	4/-			2.14	
Beans, English spring	98/-	532	20	10	3	1	17	9	66	5/4			2.86	
" winter	96/-	532	20	0	3	1	16	19	66	5/2			2.78	
" Chinese	19/-	112	19	0	3	1	15	19	66	4/10			2.60	
Peas English blue	105/-	504	23	5	2	13	20	12	69	6/-			3.22	
" dun	103/-	501	22	15	2	13	20	2	69	5/10			3.14	
" maple	113/-	504	25	0	2	13	22	7	69	6/6			3.50	
" Japanese	150/-	504	33	0	2	13	30	7	69	8/10			4.75	
Buckwheat	—	—	—	—	—	—	—	—	—	—			—	
Rye, English	84/-	480	19	10	1	8	18	2	72	5/1			2.73	
Millers' offals—Bran	—	—	14	10	2	10	12	0	45	5/4			2.86	
" Coarse middlings	—	—	15	10	2	10	13	0	64	4/1			2.20	
Barley meal	—	—	21	0	1	6	22	14	71	6/5			3.45	
Maize "	—	—	21	0	1	5	19	15	81	4/11			2.65	
Bean "	—	—	22	0	3	1	18	19	66	5/9			3.09	
Fish "	—	—	24	10	7	12	16	18	53	6/5			3.45	
Cakes, Linseed	—	—	23	10	3	12	19	18	74	5/5			2.90	
" Soya	—	—	24	0	5	4	18	16	69	5/8			2.95	
" Cotton seed	—	—	14	0	3	5	10	15	42	5/2			2.78	
" Cotton seed de-	—	—	—	—	—	—	—	—	—	—			—	
corticated	—	—	19	0	5	6	13	11	71	3/10			2.06	
" " decorticated	—	—	—	—	—	—	—	—	—	—			—	
meal	—	—	20	0	5	6	14	14	71	4/2			2.21	
Coconut cake	—	—	16	0	3	0	13	0	79	3/4			1.80	
Groundnut cake	—	—	16	10	3	9	13	1	57	4/7			2.16	
" decorticated	—	—	21	0	5	5	15	15	73	4/4			2.33	
Palm kernel cake	—	—	13	0	2	1	10	19	75	2/11			1.57	
" meal	—	—	—	—	2	1	—	—	75	—			—	
Brewers' grains, dry	—	—	11	15	2	7	9	8	49	3/5			1.83	
" wet	—	—	0	17	0	12	0	5	15	0/4			0.18	
Distillers' " dry	—	—	12	10	2	16	9	14	57	3/5			1.83	
" wet	—	—	1	1	0	13	0	8	16	0/6			0.27	
Malt culms	—	—	10	5	3	6	6	19	43	3/3			1.75	
Potatoes	—	—	4	17	0	8	3	9	18	3/10			2.00	
Swedes	—	—	1	12	0	5	1	7	7	3/10			2.00	
Mangold	—	—	1	9	0	6	1	3	6	3/10			2.00	

AGRICULTURE ABROAD.

THE CINEMA IN AGRICULTURAL EDUCATION—A NEW METHOD OF TESTING MILK—SMALL HOLDING FARMING.

In every branch of education the cinema promises to play an important and ever-developing part. This means of providing instruction in agriculture and horticulture has received the attention of the United States Department of Agriculture, and a scheme of circulating films illustrating agricultural methods and subjects has been devised, which has already met with a large measure of success. At present well over 100 films have been prepared for circulation. The number of reels available for distribution is 460, representing more than 460,000 feet of film. All the pictures are in circulation, most of them constantly, and it is calculated that in the last twelve months more than 700,000 persons have witnessed exhibitions of one or more of the Departmental films. The authorities are assured that their enterprise in this direction is making for better farming.

**The Cinema as
an Aid to
Agriculture.**

The official films are intended primarily for the instruction of "extension" students, field workers and co-operative agricultural institutions. The Department is at present unable to meet all the demands made from outside sources upon its supply, but where reels are not actually in use, every endeavour is made to lend them to societies not directly connected with the Department. No charge is made for the loan of the film, but the borrower is expected to pay the cost of carriage.

Among the subjects illustrated in this manner are the keeping of live stock, the life history of injurious parasites, dairying operations, the raising of crops, gardening, forestry, market operations, agricultural chemistry, biology, farm management and building construction. The spectators are, for example, shown the entire process of the wool industry—the flocks grazing in the national forests, the separating of lambs from ewes, feeding, shearing and marketing; the after history of the fleece, sorting and weighing, until it reaches the factory, where the cleaning, grading, spinning, winding and weaving processes carry on to the finished web of cloth.

The whole organisation of the poultry farm is shown, and the scientific side of the question is treated in a most interest-

ing series depicting the embryology of the egg. A film entitled "The Construction of a Wooden Hoop Silo" shows in fifteen minutes an operation that would require a full day to demonstrate if the class were taken to a farm where such a building was in progress. An excellent film, devised as a pleasant story, has been prepared as an auxiliary to the promotion of rural industries. While it imparts instruction, this film introduces the personal element, and so maintains the kinship of the cinema with recreation. The picture is entitled "The Home Demonstration Agent"—a United States official whose duty corresponds to that of one of the county organisers in domestic science in this country. This lady's work among women and girls in outlying country districts is faithfully traced, and its effects on the whole community are brought home to the audience. The little drama introduces the work of the egg-circle, the communal kitchen, the county encampment and picnic, and the exhibition of club work at the county fair.

THE large development of the milk trade, and also the establishment of butter factories and creameries, call for great care in ensuring that the milk purchased or sold is pure and of good quality. The percentage of non-fatty solids in milk is fairly constant, but the fat or cream content varies, and it is necessary for tests to

**The Hoyberg
Process of Testing
the Fat Content
of Milk.**

be made from time to time to determine whether the amount of fat in the milk is or is not below the "standard." Such tests are commonly made with an apparatus known as the butyrometer, invented by Dr. Gerber. This apparatus consists of a number of test tubes in which the milk can be specially treated for testing. Definite quantities of milk and acid are mixed in a specially constructed test tube, and the tube is rotated at high speed. The fat is in this way separated from the remainder of the milk, and driven into a narrow tube graduated so as to enable the percentage of fat contained in the sample to be measured.

A method of testing the fat content of milk on somewhat similar lines has recently been designed by Mr. Hoyberg, Veterinary Officer to the Commune of Frederiksberg, Copenhagen, and has attracted some attention in dairy circles. Observations on this process have been made by three

authorities on dairying*, and an account of their investigations and conclusions was published in the issue of the *Milchwirtschaftliches Zentralblatt* for 15th April, 1920. The results suggest the possible value of the Hoyberg process as compared with the Gerber process, although it should be stated that Hoyberg's investigations are not yet complete.

Each butyrometer in the Hoyberg process is filled with 9.7 cc. of milk, to which are added 8.4 cc. of one and 0.6 cc. of a second fluid (both of secret composition), carefully measured, and the tube then closed with a rubber stopper. The contents are mixed by turning the butyrometers five or six times, shaking for $\frac{1}{4}$ minute, and again turning as before. The tubes are afterwards allowed to stand in a water bath at a temperature of 60° to 62°C., stoppers uppermost, for 6 or 7 minutes, after which the previous operation of turning and shaking is repeated. The butyrometers are finally again placed in water, stoppers uppermost, for 8 to 10 minutes, and then in a reverse position for a further period of 5 to 10 minutes.

As a result of this treatment the fat is separated from the rest of the milk. The amount can be read off on the graduated scale.

The whole apparatus and fluids can be packed in a well-fitted tin box, which is easily portable.

In the account given by the three investigators, the results of five samples of milk so treated are tabulated, and it is shown that they correspond very closely with those obtained by the Gerber process. One-half of the milk used was preserved with formalin (one drop to 50 cc. of milk), and the other half cooled, and further tests were made on the following day. These results showed differences in some cases up to 15 per cent, and in one case (in the milk preserved with formalin) 20 per cent. Further tests with other samples of both whole and thin milk were made later, and generally confirmed the results previously obtained.

Mr. Hoyberg mentioned the following three points with regard to his process:—

(1) Investigations are not yet complete as to whether the process is suitable for milk from cows just calved, for milk from dry cows, or other abnormal milks.

(2) The process is unsuitable for skim-milk, as the results given are too low.

* B. Van der Burg, Professor of the Agricultural High School of Wageningen; W. Keestra, Director of the State Dairy School, Bolsward; and D. C. de Vaal, Director of the Cheese Central Station, Alkmaar.

(3) When milk samples have to be kept, the preservative to be used must be formalin. It would appear that bichromate of potassium is ill adapted for this purpose, but investigations on this point are not yet complete.

In discussing the results of their observations from the experiments, the writers state:—

(1) With fresh milk the agreement between the Hoyberg and the Gerber process is fairly accurate, provided that the fat determination process develops according to Mr. Hoyberg's desire, although differences up to 15 per cent., and in one case 20 per cent., occurred, and in general the Hoyberg method gives too low a figure.

(2) The process is easy to carry out and the rules are simple, although in spite of this simplicity some peculiarities occur which are difficult of explanation.

(3) In arranging the submersion in the water bath as a means for doing the necessary shaking, the inventor has made the shaking and turning portion of the process much less troublesome, although this was not borne out with the apparatus for six samples placed at the disposal of the investigators.

(4) In some experiments, in which three samples were tested, one sample in two butyrometers showed a dark fat layer or a flocculent serum, or both, whilst the other two samples remained perfect. In the course of the process of fat determination, also, more or less serious deviation in the readings was found. The investigators consider it quite possible that anyone making constant use of the Hoyberg method would find means of avoiding such undesirable occurrences; at the same time, it must always be a disadvantage that the investigator can, unconsciously, make small errors which could lead to a partial failure of the experiment and to erroneous conclusions.

(5) Reckoning up the time spent in carrying out Hoyberg's process in accordance with his rules, the investigators state that 25 minutes are required from the moment of closing the butyrometer until the time of reading off. This period is longer than with the Gerber process.

(6) The great advantage of Hoyberg's method over Gerber's is the omission of the shaking. The full advantage of this is not felt when the milk experiments are being made in a laboratory fitted up for this purpose, but it is a different matter if the experimenter has to go from one place to another to carry out his investigations.

(7) Milk tests for checking the yields of cows could be carried out on the spot more easily by the Hoyberg than by the Gerber method, and this, in certain circumstances, would mean a considerable simplification from the point of view of the milk tester.

(8) If, in regard to accuracy and reliability of results, the Hoyberg method fulfilled reasonable requirements—which the writers state as a result of their investigations they are not in a position to confirm—then it might perhaps replace the Gerber method in localities where it is extremely difficult and, at the same time, causes great loss of time, to collect all milk samples for investigation in a laboratory. The writers sum up as follows:—

On account of its simplicity Hoyberg's method might be preferable to Gerber's in certain circumstances. This simplicity, however, gives rise to no saving in time, and on balance, does not outweigh the disadvantage that his process is less reliable.

* * * * *

At the present time, when the advantage of small holdings is so much discussed, it is instructive to turn to a report on the economics of small farms issued by the United States Department of Agriculture.* **The Economics of Small Farming.** The Bulletin referred to presents the results of a study of the organisation of small farms in the neighbourhood of Washington, D.C. Information was obtained regarding the important and outstanding agricultural practices followed on 152 small farms, and an analysis was made of the business of each of these farms to ascertain the amount of capital used, the kind and quantity of crops raised, and of live stock kept, and the details of the financial position. Under the last head the investigator examined the nature and volume of receipts, the expenses incurred, the return realised, and other facts bearing on the organisation and operation of the holding.

The farmers visited were men whose main source of income was obtained from the produce of their farms. Each operator devoted most of his time to labour and supervision. Men who had a regular occupation elsewhere, and whose farming was merely recreative, did not come into the survey, as their work was manifestly not comparable with that of men who gave

*Bull. No. 848, United States Dept. of Agriculture, "An Economic Study of Small Farms near Washington, D.C."

their whole time to the land. The data presented apply to the crop year of 1916. The general conditions of yield and prices were fairly normal, as the effects of the European War had not yet materially changed farming profits or farm management in the region under consideration.

All the farms in question were devoted to market gardening. Over 50 per cent. of their total crop area consisted of vegetables and fruits, and 90 per cent. of the receipts were from this source. It was found that, judged by the farm standard, land values were high. The farm produce was disposed of by conveying it to the city and selling it either in the public market or through commission agents. As the farms increased in area the proportion of land used for general crops (corn, hay and grain) increased, but on many of the small holdings no corn or grain was raised, so that feed had to be bought. The live stock was limited to the horses required for farm work and to the cows, pigs and chickens kept for the production of food for the family. With the exception of poultry, sales of live stock were negligible.

The average flock was 33 chickens. In the area examined there were no green-houses for raising market vegetables. Of the farms inspected, the 45 showing the lowest investment had also the lowest income. The average crop area on these was 6 acres. In this group only five of the farmers made a labour income of over £80. Labour income is the amount of money left over after paying all business expenses and deducting interest on money invested. Farms under 10 acres in the region under consideration did not afford any great chances of large income, and it was noted that only the exceptional farmer can make more than a living on such small farms without any outside source of revenue. Incomes, however, rise very rapidly with the increase in the tillage area. A second group of holdings of 11-20 acres each make an average labour income of about £45, while two out of every five make over £80. Farms between 21-30 acres yielded incomes averaging over £80, and the same applied proportionately to the farms of over 30 acres.

The report points out that a farmer of 10 acres and under need not assume that he could not do better than the average, but must bear in mind that if he is to obtain more than the average income the most careful management and a considerable knowledge of farm practice and markets are necessary, while most of the farm work will have to be done by himself and his family. The small farmer has to buy nearly all his stock feed,

as he has not land enough to produce the more cheaply raised foods, such as hay, corn and green fodder. The larger farmer must spend relatively more money than the smaller for labour, fertilisers and marketing, but the costs for food are less.

One great source of profit is double cropping. The importance of having continuous cropping cannot be over emphasised. Many market-garden products reach maturity in less than a season. If it is not possible to follow or precede a short-growing crop with another market-garden crop, a winter cover crop or summer legume should be sown to be ploughed in for the improvement of the soil. Inter-cropping is also advantageous.

Two-fifths of the farms inspected had less than half their area in crops, the remainder being woodland, scrub and a negligible part in pasture. The half of the farms in crop had to pay interest and taxes on the non-productive part. As the tillage area decreased in proportion to the total farm area, the business became smaller, and in addition was burdened increasingly with idle capital.

When all the farms having 30 acres and under of tillable land are classified into two groups, (A) those in which the tillable area is 60 per cent. and less of the farm area, and (B) those in which it is over 60 per cent. of the farm area, it is found that the former group returned an average income of about £15, and the latter an average of £93. The disadvantage of leaving waste land idle is thus obvious.

The occupiers of the farms under consideration require a relatively small amount of capital. The farm income of the tenants was less than that of the owners, but if the net interest of the capital invested be deducted, the net income is about the same for both groups. The prospective farmer with the necessary experience but with little capital can do better by renting than by buying until he can afford to get a farm of sufficient size for profitable cultivation.

Application for Licences under the Horse Breeding Act, 1918.—Owners of stallions who intend to travel their horses next season are reminded that they will require licences to enable them to do so.

Applications for licences in England and Wales may be sent to the Ministry on or after the 1st November, by which date the licences for the season of 1920 expire and should be returned to the Ministry. Failure to return any expired licence renders an owner liable to a fine of five pounds.

Forms of application for licences can be obtained from *The General Secretary, Ministry of Agriculture and Fisheries, Whitehall Place, London, S.W.1*, and, as the Ministry cannot undertake to arrange for the veterinary examination of stallions at short notice, owners are advised to send in their applications as soon as possible after the 1st November. If many defer doing so until the service season approaches it will not be possible to deal with all applications before the season commences.

Imported Seed Potatoes from Scotland.—The Ministry desires to bring to the notice of potato growers and merchants the revised regulations which are now in force with respect to the importation of seed potatoes from Scotland into England and Wales.

The Board of Agriculture for Scotland have recently issued an Order under which, in every case of a consignment of seed potatoes (other than certified stocks of immune varieties) to this country, the exporter in Scotland is required to obtain a certificate from the Board of Agriculture for Scotland to the effect that Wart Disease has not existed on or within one mile of the place in which the potatoes were grown. Further, the exporter must send with each consignment a declaration correctly stating the reference number of the relative certificate. In the case of certified stocks of approved immune varieties, the exporter must send with the consignment a declaration correctly stating the serial number of the certificate of purity issued in respect of the growing crop. The Ministry proposes now to supplement the Order of the Scottish Board by requiring that any importer who receives "seed" potatoes from Scotland which are not accompanied by the necessary declaration shall report the fact to the Ministry within seven days of the receipt of the potatoes. Any person desiring further information on this subject should communicate with the Ministry at 72, Victoria Street, London, S.W.1.

Export of Potatoes to Holland.—The Ministry has received official notice that the Netherlands Government have introduced regulations governing the importation of potatoes into Holland. These regulations require that potatoes grown in England and Wales shall be imported only in bags which have been sealed by an Inspector of the Ministry, and that at the time of importation a certificate must be produced from the Ministry stating that the potatoes were grown in land on which Wart Disease has not occurred. Growers and exporters of potatoes are warned, therefore, that they should not export to Holland any potatoes other than those which have been inspected by the Ministry. Immediate notification should be made to the Ministry by any persons desiring to export potatoes to Holland, in order that arrangements may be made for the inspection of such potatoes at the time of lifting.

Leaflets issued by the Ministry.—Since the date of the list given on page 690 of last month's issue of this *Journal*, the following leaflets have been issued :—

- No. 346.—Gooseberries.
- „ 347.—Profitable Pears for Market.
- „ 355.—Growing Wild White Clover and Late-Flowering Red Clover for Seed.
- „ 359.—Bracken as Litter. (Previously issued as Food Production Leaflet No. 16.)

In addition, the information in the following leaflets has been revised and brought up to date :—

- No. 44.—Lapwing, Green Plover or Peewit.
- „ 80.—The Use of Artificial Manures.
- „ 151.—Cleanliness in the Dairy.
- „ 161.—The Vapourer Moth.
- „ 180.—Dodder.
- „ 187.—The Selection and Milking of Dairy Cattle.
- „ 197.—Agricultural Education and Research in England and Wales.
- „ 250.—Domestic Fruit Bottling with or without Sugar.
- „ 254.—The Use of Seaweed as Manure.
- „ 274.—Parasitic Mange in Horses, Asses and Mules.
- „ 314.—The Manurial Value of Shoddy.
- „ 334.—How to Increase Stocks of Bees.

Foot-and-Mouth Disease.—*Sussex (East).*—No further development has occurred in this district, and the whole of the general restrictions imposed on account of the outbreaks near Uckfield in August last were removed as from the 26th September last.

Kent (Faversham District).—Two outbreaks occurred in this district on the 20th and 30th September at Baddlesmere, near Faversham, but no further extensions having occurred, the restrictions were removed as from 6th October from all but an area having a radius of about 5 miles from the outbreaks, in which movement remained prohibited. The restrictions applicable to this area were subsequently modified on the 13th October and removed as from the 21st October, except from two smaller prohibited areas around the actual premises on which disease existed. At the time of going to press (25th October) it is hoped that in the absence of any unforeseen developments it will be possible to withdraw all general restrictions from this district as from the 28th October.

Rabies.—*Wiltshire.*—One further outbreak of Rabies has occurred, at Salisbury, since the last issue of this *Journal*.

As a consequence of the confirmation of the case in the stray dog at Potterne, near Devizes, previously referred to, it was deemed necessary to extend the limits of the scheduled district on the West and North-eastern sides of the existing district, and at the same time to enlarge the limits of the inner controlled area.

Glamorgan.—No developments have occurred in this district, and the restrictions remain in force without modification.

Berkshire.—On the 23rd September, the existence of Rabies was confirmed at Reading. The dog, an aged fox terrier, first showed symptoms of illness

on the 19th September, and was taken to the premises of a Veterinary Surgeon, where it died two days later. In view of the suspicious symptoms, the case was reported to the Police and the dog's head sent to the Ministry's laboratory, where examination confirmed the existence of Rabies.

An Order imposing the usual muzzling and movement restrictions over a wide area around Reading was accordingly issued on the following day. This area comprises portions of the counties of Berkshire, Oxfordshire, Buckinghamshire, Surrey and Southampton. As from the 30th September, an inner or dangerous area having a radius of about 5 miles around Reading was prescribed. Within this inner area all dogs in a public place are required to be led as well as muzzled, and in any other place, not being a public place, to be muzzled at all times unless they are tied up or confined within an enclosure from which they cannot escape.

Since the original outbreak, three other outbreaks have been confirmed, viz., two on the 7th October and one on the 13th October, all at Caversham, Reading.

In consequence of the history attaching to one of the dogs concerned, it was necessary on the 7th October to extend the inner controlled area so as to include the district lying between Wallingford and Henley-on-Thames.

The movement of dogs out of the inner area and out of the scheduled district is prohibited except by licence of the Minister and subject to quarantine on approved veterinary premises.

Importation of Hops.—As there appears to be some misunderstanding with regard to the importation of hops, it is desired to state that hops may not be imported into the United Kingdom unless with a permit issued by or under the authority of the Food Controller. This regulation is imposed with a view to assisting the industry of hop growing in the United Kingdom to recover from the injury which it suffered during the War.—(*Board of Trade Journal*, 14th October, 1920.)

Free Entry for certain Agricultural Machinery into Tunis.—A Decree of the Tunisian Director-General of Finance, dated 3rd September, authorises the admission, free from Customs duty, of agricultural machinery and apparatus destined for the "Motoculture" exhibition to be held at Tunis in March, 1921. Machinery and apparatus imported duty-free under this Decree must be re-exported within two months of the closing of the exhibition.—(*Board of Trade Journal*, 14th October, 1920.)

SELECTED CONTENTS OF PERIODICALS.

- A Strawberry Bibliography, *C. H. Payne*. (Jour. of Pomology, Vol. I., No. 4, Aug., 1920.) [01; 63.41(c).]
- Variations in the Numbers of Livestock and in the Production of Meat in the U.K. during the War, *J. B. Guild*. (Jour. Roy. Stat. Soc., July, 1920.) [63.6: 81; 63.75.]
- Sawdust Chemically treated is tried as a Stock Food. (Hoard's Dairyman, Vol. LX., No. 4, Aug. 18th, 1920.) [63.604(a).]
- Wart Disease of Potatoes, *G. C. Gough*. (Jour. R.H.S., Vol. XLV., Parts 2 and 3, July, 1920.)
- On the relations between growth and environmental conditions of temperature and bright sunshine, *W. E. Brenchley*. (Ann. of App. Biol., Vol. VI., No. 4.) [575.]
- Aus einer Feldstation für Stechmücken, *Dr. F. Eckstein*. (Zeits. f. angewandte Entom., Band VI., Heft. 2, 1920.) [59.169(c)]
- Technic of Potato Starch Manufacture, *C. C. Moore*. (Potato Mag., Vol. 3, No. 1, July, 1920.) [63.344.]
- Die Marschkulturkommission, ihre Entstehung Aufgabe und Tätigkeit, *Dr. Br. Tacke*. (Landw. Jahrb. Band LIV., Erg. 1., 1920.) [63.142.]
- Die Wertverluste des Kalkstickstoffs beim Lagern, *Dr. F. Weiske*. (Landw. Jahrb. Band LIV., Heft 4, 1920.) [63.1623.]
- Early English Forest Regulations, *J. D. Guthrie*. (Jour. of Forestry, Amer., Vol. XVIII., No. 5, 1920.) [34.]
- Some Bee Diseases, *J. Tinsley*. (Scot Jour of Agric., Vol. III., No. 3.) [63.81.09.]
- Scottish Pure Bred Livestock.—IV., Highland Cattle, *J. Cameron*. (Scot Jour. of Agric., Vol. III, No. 3.) [63.602.]
- Flax and its Cultivation, *P. Ryan*. (Jour of Agric., Vict., May, 1920.) [63.3411.]
- Branding and Ear-marking Stock, *H. A. Mullett* (Jour. of Dept. of Agric, Vict., May, 1920.) [63.6]
- Der Hund in der Geschichte und Saga, *K. Balz*. (Zeit. f. Forst. v. Jagdw., Band LIII., Heft 4, 1920.) [63.67.]
- Bericht über eine Prüfung des Hoyberg'schen Verfahrens zur Milchfettbestimmung. (Milchw. Zentralblatt, Jahrgang 49, Heft 8, 1920.) [63.712.]
- Studies on the Influence of Humidity upon the Strength and Elasticity of Wool Fiber, *J. I. Hardy*. (Jour. Agric. Res., Vol. XIX., No. 2, April, 1920.) [63.761.]
- The Use and Making of Ensilage, *A. J. Perkins*. (Jour. of Agric of S. Austr., Vol. XXIII., No. 12, July, 1920.) [63.1985.]
- Electro-Culture, *F. J. Rae*. (Jour. of Dept. of Agric., Victoria, Vol. XVIII., No. 7, July, 1920.) [537.]
- The Antagonistic Action of Calcium and Iron Salts towards other Salts as measured by Ammonification and Nitrification, *J. E. Greaves*. (Soil Science, Vol. X., No. 2.) [63.118.]
- Resultats des Experiences dans la Forêt de Lamotte Beuvron. (Rev. des Eaux et Forêts, Tome LVIII., No. 9, Sept., 1920.) [63.196.]
- Forskene i havebruket (Spraying for Weeds—its effect on ordinary kitchen garden crops.) (Beretning om Fjerde Skoleaar, 1918. Statens Smaabrukslaerer-skole.) [63.29; 63.295.]
- Lightning Injury to Herbaceous Plants, *Jones and Gilbert*. (Phytopathology, Vol VIII., No. 6, June, 1918.) [63.21.]

THE JOURNAL OF THE MINISTRY OF AGRICULTURE

Vol. XXVII. No. 9.

DECEMBER, 1920.

NOTES FOR THE MONTH.

IN consequence of repeated applications from agriculturists throughout the country for a verbatim report of the Minister's

The Minister's Speech at Leicester. Speech is printed *in extenso* on pp. 816 to 880. Reprints are available free of charge on application to the Ministry's Office, 3, St. James's Square, London, S.W.1.

ON 23rd December last, Royal Assent was given to the Ministry of Agriculture and Fisheries Act, 1919,* a measure

The Formation of County Agricultural Committees. framed to reorganise, on more efficient and uniform lines, the machinery for dealing with agricultural matters. The first and second parts of the Act provide for the substitution of a Ministry in place of the Board of Agriculture and Fisheries, and for the establishment of Councils of Agriculture for England and Wales, as well as an Agricultural Advisory Committee.

It is with Part III of the Act that this note is concerned. This Part requires that every County Council shall establish an Agricultural Committee, of which not less than two-thirds of the members are to be appointed by the County Council, although they need not all be members of the Council, the remainder being appointed by the Minister. In practice, the majority of Councils have accepted a suggestion made by the Ministry that a proportion of the members to be appointed

* Notes explaining the main provisions of this Act appeared in this *Journal*, January, 1920, p. 362, and February, 1920, p. 1129.

by the County Council should be selected from among the nominees of agricultural organisations having branches in the county.

It should be emphasised that the Act is not concerned with agricultural policy, nor is it designed to supersede any Committee of the County Council previously dealing with a particular branch of agricultural administration. Its intention is to co-ordinate existing Committees, to fit them into a general scheme, and to bring within the purview of a single Committee, assisted by a number of Sub-Committees, all the numerous powers and duties of the County Council relating to agriculture; thus affording that industry in each county a position appropriate to its importance.

The wide scope of these Committees may be judged from the fact that they will, as a general rule, administer, either directly or through the medium of Sub-Committees, the Small Holdings and Allotments Acts, the Diseases of Animals Acts, the Destructive Insects and Pests Acts, the Fertilisers and Feeding Stuffs Act, Part I of the Land Drainage Act, 1918, and the Rats and Mice (Destruction) Act. In addition, most, if not all, will have delegated to them the Minister's powers under Regulation 2M of the Defence of the Realm Regulations relating to the increase of food production, and, on the expiration of those powers, the similar powers conferred by Part IV of the Corn Production Act, 1917, as well as the powers under Part II of the Land Drainage Act, 1918. They will become responsible for the work of the existing County Live Stock and Horse-breeding Committees, and will, in some instances, supervise agricultural education in the county. Besides undertaking the administration of these important enactments, Agricultural Committees will include among their duties the task of fostering rural industries and initiating schemes for the general enrichment of social life throughout the countryside.

The first step towards setting up the Committees has been the preparation by each County Council of a Scheme for the establishment of the Committee, which was subject to approval by the Minister. In order to assist Councils in this respect the Ministry formulated a Model Scheme, and it is gratifying to observe that almost every County Council has adopted the general provisions of the Model, with such minor modifications as were found expedient to meet the peculiarities of the county. The last of the Schemes to be submitted to the Ministry received final approval early in September.

Considerable progress has been made in setting up the Committees, and also the Sub-Committees which are to be responsible for the detailed work of administration. At the end of October, in 54 out of the 62 administrative counties in England and Wales (excluding London, where it has been decided not to establish a Committee, but including the Isles of Scilly) one or more meetings of the Committee had been held. In all other cases the Committees are now complete, and the first meeting will shortly be held.

Even when a Committee is complete it is still necessary for much to be done in the formation of Sub-Committees, some of which have to carry out the duties of existing Committees with statutory powers. It is, however, confidently expected that, before the end of the year, every county will have its new organisation in full working order.

* * * * *

THE reclamation of waste land was the subject of an address delivered by Dr. E. J. Russell, the Director of the Rothamsted Experimental Station, on 5th November, to

**The Reclamation
of Waste Land by
Agricultural Means.**

a meeting of the Association of Economic Biologists. The speaker first made brief reference to cases in which the problem was mainly an engineering one, namely, on land which was inaccessible either owing to the absence of roads or to the soil being so wet that implements and animals could not be got on to it. Reclamation in such cases is a question of the provision of good roads and of proper drainage. An instance mentioned was the area between the rivers Crouch and Blackwater in Essex. The neighbouring island of Foulness has been reclaimed by building a wall to prevent floods and by drainage, and is now valuable agricultural land

In some cases the land is waste through some inherent defect, e.g., thinness of soil with an underlying stratum of rock. If this stratum is thin and there is a good soil underneath, the problem is to remove the rock and join up the two sections of good soil. When, however, the rock underneath the thin soil is solid rock, there is no practical means of solving the problem.

In dealing with the question of reclamation by purely agricultural means, Dr. Russell divided the requirements of plants and soil organisms into five categories, namely: (1) Nutritive materials and energy supply; (2) Air; (3) Water; (4) Suitable temperature; (5) Absence of injurious conditions.

The problems of reclamation presented by categories 2, 3 and 4 are the same in practice, so that there are really only three factors which need to be considered, and since the absence of nutritive materials (category 1) can be remedied by the use of artificial fertilisers, the number is still further reduced to two, namely, water supply and injurious conditions.

The speaker took as a datum rainfall line the 30-in. rainfall line from Northumberland to the Isle of Wight. He stated that the waste land problem east of this line is largely due to deficient water supply, and to the west frequently to the presence of harmful substances, particularly acid peat. The problem in the former area is solved by bridging the gap between soil conditions and crop, namely, by growing special crops and by altering soil conditions to suit the desired crops.

The constituents of cultivated land which fall to be considered in examining agricultural methods of reclamation are sand, silt, clay, organic matter and calcium carbonate. Land may be waste through excess of sand, clay, or organic matter, or through acidity. Some constituents, as, for example, organic matter, may be lacking, and the method then adopted is to grow and plough in green crops such as red clover, &c.

Examinations of waste areas are carried out by comparing the mechanical analysis of the soil of waste land with that of adjoining poor land, and also of adjoining better agricultural land. Such an analysis reveals the factors which are in excess or otherwise on the waste land as compared with the agricultural land.

Sandy Soils.—Dr. Russell first dealt with soils on which there is a large excess of sand, *e.g.*, on the Lower Greensand and the Bagshot sands in Surrey. The higher land in such cases is usually too dry and the lower too wet, with the result that ripening of cereals is hastened on the high land and retarded on the low, and unevenness in crop occurs. Where the slope is a long and gradual one, however, more uniform conditions over a larger area are obtained, and the land can be cultivated; here the underground drift of water makes the conditions much better. The remedy adopted abroad in the case of dry sands is irrigation, but this is not possible in this country, and the problem has therefore been approached by attempting to diminish the loss of water due to evaporation and to soaking into the sub-soil.

The method adopted is to increase the colloidal properties of the soil by adding either clay or decomposing cellulose.

Claying was formerly used a great deal, but at the present time the method is too expensive, as about 50 tons to the acre would be required. The practice followed, therefore, is to increase the organic matter. One method is to add farmyard manure, as is done by the market gardeners in the Biggleswade district. Crops are sold in the towns, and stable manure is carried back from the towns to the market gardens and dug in the sandy soil. Land which would otherwise be poor is thus made to produce heavy crops. The method is only feasible in the case of market gardens, and is too expensive for ordinary agricultural adoption.

The agricultural method is to run sheep over crops of swedes, rape and vetches, the sheep being confined within hurdles. In this case the expense of cartage is avoided, since there is no need to carry the manure to the soil. The Lower Greensand in Surrey and Sussex and other parts have been improved in this way. The practice is carried out in winter, because the soil may be too hot for the sheep in summer.

A further agricultural practice in reclaiming waste sand is that of green manuring; lucerne, vetches, lupins, &c., are grown and ploughed in, either whole or with the tops previously cut off, and used for stock feeding. This method has been adopted at both Woburn and Rothamsted, but it has the disadvantage that if the whole of the green crop is ploughed in no money return is obtained for that season. The practice, therefore, usually resolves itself into the top being cut or fed and the rest ploughed in. This means, of course, that the process of reclamation is much slower. The making of the crop into silage prevents any waste in its use for feeding to animals. A mixture much in vogue is oats and tares. The first crop on waste land may be low, but as the process is repeated in successive years with a suitable fertiliser scheme, the improvement becomes more and more marked. Suitable crops to follow the green manuring are potatoes, carrots, barley, rye, kidney vetch and lucerne.

Chalky Soils.—The soil collects in the bottom land, but becomes thin on the higher land. The method adopted is to cultivate the lower parts of such areas and to improve the herbage on the higher land by the use of basic slag.

Clay Soils.—Rain makes such soils nearly impassable for horses and implements, which in some cases can only be usefully employed on the land for about 50 days in the year. Formerly,

the practice was to employ a large number of teams to perform the ploughing in the short time available, but the introduction of the tractor has helped considerably in solving the problem of the reclamation of clay lands.

The addition of chalk deflocculates clay, *i.e.*, changes it from a sticky to a more permeable condition. The best crops for poor clays are wheat, beans, mangolds, kohlrabi (but not swedes) and grass. Of these, the best is grass, but wheat does well.

Peaty Soils.—Dr. Russell also dealt with the reclamation of peaty soils. No account of this part of his address is given here, as it is hoped to publish an article on this question shortly.

* * * * *

Owing to the conditions prevailing in the counties of Cumberland and Westmorland, there is at present an excellent opportunity for these two counties to develop into a first-class district for the production of seed potatoes. Undoubtedly a large acreage in both counties is suitable for the cultivation of potatoes, and the seed which has been raised in them has produced excellent crops elsewhere in the country. The operation of the present higher charges for the railway carriage of seed will assist a development in this direction by inducing growers in the South to seek nearer sources of seed than those on which they have been accustomed to rely.

**Cumberland and
Westmorland
as Nurseries for
Seed Potatoes.**

Immune Varieties.—Farmers who intend to take advantage of this opportunity should remember that in the near future the demand for "seed" will tend to become restricted to those varieties of potato which are immune from wart disease. They should bear in mind, also, that the present high cost of crop production will further restrict this demand to the best and purest stocks of seed only. It is important, therefore, that farmers in the counties of Cumberland and Westmorland should take advantage of the Ministry's Scheme for the inspection and certification of crops.

The Certification of Crops.—Applications for the inspection of growing crops of immune varieties of potato should reach the Ministry before the 1st July. Crops which, on inspection, are found true to type and free from admixture of "rogues," will be certified as such and given a serial number which

should be quoted to purchasers, in order that they may be assured of the purity of the stock they are purchasing.

The best immune varieties are:—

First Early.—Immune Ashleaf, Dargill Early, Resistant Snowdrop or Witch-Hill, America, Arran Rose;

Second Early.—Great Scot, King George, The Ally, Nithsdale;

Main Crop.—Kerr's Pink, Majestic, Tinwald Perfection, Irish Chieftain and Rhoderic Dhu.

The following additional information as to the regulations of the Ministry with regard to Infected Areas under the Wart Disease Order of 1919 may be useful.

The Policy relating to the Planting of First Early Varieties in Wart Disease Infected Areas.—Owing to present lack of suitable first early varieties immune from wart disease, the Ministry does not, for the time being, propose to restrict the planting of first early varieties in Infected Areas to those which are immune, and has made the following concession:—

On land situated within an Infected Area, but on which disease has not actually occurred, occupiers may plant the following first early varieties:—

Duke of York (or Midlothian Early or Victory), May Queen, Ninetyfold; Epicure, Sharpe's Express; Ringleader; Eclipse, Sir John Llewellyn, and Puritan, and any others that may be hereafter approved by the Ministry for the purpose.

If "seed" for this purpose is required to be *introduced* into an Infected Area, a licence from the Ministry will be necessary.

This policy will remain firm until May, 1924. All potatoes grown under this concession must be used or consumed within Infected Areas.

The Wart Disease Order.—The main requirements of this Order are as follows:—

(1) If disease appears, or re-appears, on any land, or is found in potatoes in any kind of store, the occupier of the land or the owner of potatoes must at once notify the Ministry.

(2) Only seed of immune varieties, certified as such by the Ministry, or otherwise specially licensed by the Ministry, must be planted in an Infected Area, or brought into an Infected Area for planting (except the variation referred to above as to First Early varieties).

(3) Seed raised in an Infected Area must not be sold for planting in land which is not within an Infected Area.

(4) Tubers visibly affected with wart disease must not be sold or offered for sale for any purpose.

A fine of £10 may be inflicted for each and every contravention of any of the regulations mentioned above.

Copies of the Wart Disease of Potatoes Order of 1919, Leaflet No. 105 on Wart Disease, and a Map showing the distribution of Infected Areas in Scotland (see p. 891), may be obtained on application to the Ministry.

UNDER the Testing of Seeds Order, 1918, it is necessary, in the case of a sale of any of the principal farm or garden seeds, for the seller to declare to the purchaser certain particulars with regard to the quality of the seed, the percentage of germination, percentage of purity, presence of injurious weeds, &c.

**The Purchase
of Seeds.**

Farmers, gardeners, allotment holders and others should be careful to ensure that this declaration is made to them in the proper manner, and if the seedsman from whom they purchase their seeds fails to meet his obligations in this respect the matter should at once be brought to the notice of the Ministry. The use of good seed with a high germination and free from impurities, particularly of noxious weed seed, is essential for high crop production. Cheap, low-quality seed is wasteful and uneconomical, while the sowing of lots of seed infested with noxious weeds will naturally mean extra work in the eradication of weeds.

There is now no reason why a farmer should *unknowingly* purchase such low grade seed. If he does he has himself only to blame, as the seedsman is required by law to disclose all the essential particulars as to the quality of the seeds he sells.

If a farmer suspects that a parcel of seeds is not up to the standard guaranteed by the seedsman he should forward a sample to the Official Seed Testing Station for a check test to be made. The fee charged for testing farmers' samples, i.e., samples of seed which the farmer himself is proposing to sow, will be, from the 1st December, 6d. per sample. Hitherto the fee has been only 3d., but owing to the marked increase in the cost of materials and labour, the expense involved in carrying out an individual test is greater even than the fees charged for samples of seed intended for sale, so that it has been found necessary to double all testing fees.

The fees to be charged at the Official Seed Testing Station for samples received on and after the 1st December next will therefore be:—

	Per sample.
For farmers' samples, as described above	6d.
For samples of seed when the test is required for the purpose of a declaration for sale—	
Cereals... ..	2/-
Roots and vegetables, other than mangold and beet	3/-
Mangold, beet, grasses and clovers	4/-

The address of the Official Seed Testing Station for England and Wales is 18, Leigham Court Road, Streatham Hill, London, S.W.16.

Administration of the Testing of Seeds Order, 1918.—The system of inspection adopted in connection with the enforcement of the Order consists in visiting markets and the premises of seed merchants and farmers who have seeds for sale. The main purpose of these visits is to ascertain whether the regulations are being properly carried out, to examine stocks of seeds, and to draw control samples, which are sent to the Official Seed Testing Station for the particulars declared by the seller to be checked.

Up to the 31st July, 1920, Inspectors of the Seed Control Branch of the Ministry had visited upwards of 3,250 establishments, many on two or more occasions.

In the majority of cases the assistance given by the Inspectors in interpreting points of the Order was greatly appreciated, and in no case was any serious difficulty met with in connection with the taking of control samples.

The number of control samples taken during the 1919-20 season was as follows:—

Root seeds	171
Clover	420
Grasses	318
Farm seeds	67
Cereals	28
Vegetables	202
Total	1,206

In addition to the above some 800 small packets of seeds were obtained by the Ministry's Inspectors.

The reports of the Official Seed Testing Station on the 1,206 samples showed that only 109, or about 9 per cent., gave results which indicated that the declaration made by the seller was radically wrong. These included 8 samples of root seeds, 48 of clover, 84 of grass and 19 of vegetable seed.

The nature of the inaccuracies in the declarations may be summarised as follows:—

(a) *Germination.*

17 cases in which the discrepancy amounted to from 10 to 15 per cent.

5 " " " " " " 15 to 20 "

14 " " " " " " over 20 per cent. "

(b) *Purity.*

15 cases in which the discrepancy amounted to from 3 to 5 per cent.

6 " " " " " " 5 to 10 "

4 " " " " " " over 10 per cent. "

(c) In 20 cases the presence of dodder was not declared.

(d) In 22 cases the percentage of injurious weed seed was incorrectly declared.

(e) In other cases the declarations were either incomplete in some details or were not given at all.

The policy of administering the Order in a non-penal manner was continued during the 1919-20 season, and no legal proceedings were taken in connection with any of the above breaches of the Order. In every case, however, the attention of the seller was drawn to the circumstances, and his observations invited. As a result the seed was in most cases either returned to the wholesaler or withdrawn from sale as seed, or the declaration was varied to correspond with the results of the official check test. The commonest defence made by retailers was that they were repeating the declaration of the wholesaler. It was pointed out that in such instances the last seller is responsible for the accuracy of the declaration, and that it is advisable for retailers, in their own interests, to have seed retested from time to time to check the correctness of the wholesaler's declaration.

Testing of Seeds in the Future.—The Testing of Seeds Order, 1918, will remain in force until the 1st August next, when the Seeds Act, 1920 (see this *Journal*, October, 1920, page 604), comes into operation. Declaration of particulars of seed sold will then be compulsory under this Act.

Copies of the Order (price 1d. net) and of the Act (price 2d. net) may be obtained from His Majesty's Stationery Office, Imperial House, Kingsway, London, W.C.2.

THE Smithfield Fat Stock Show, held by the Smithfield Club, takes place this year from 6th to 10th December. It is chiefly an exhibition of cattle, sheep and pigs. The animals are first of all exhibited alive and are afterwards slaughtered, the carcasses being quartered, weighed and judged. The live and

dead weights are recorded above each carcass, which is finally sold by auction. Of late years, table poultry has been included in the show.

This well-known exhibition dates from 1799, when the Smithfield Cattle and Sheep Society, instituted in the previous year, held its first show at Wootton Livery Stables in Dolphin Yard, Smithfield. There were four classes, two for cattle and two for sheep, and the prizes offered amounted to 50 guineas. In 1802, the title "Smithfield Club" was permanently adopted. At the first meeting there were 113 members; the number is now over 1,000. In 1800 the Duke of Bedford, then President, in a speech delivered at the annual dinner, defined the real aim of the Society. "Without doubt," said His Grace, "there are two things we are most solicitously to avoid. First, most certainly not to associate to raise prices, and secondly, we ought to prepare no measure which might have even the appearance of raising the prices. The only true object of the farmer is to profit, not by high prices, but by great products."

The primary aim of the Smithfield Club is to encourage the selection and breed of the best and most useful animals for the production of meat and to test their capabilities in respect of early maturity. Owing to the latter consideration, no animal more than three years old is shown, except in the case of Highland cattle. In the opinion of the Secretary of the Smithfield Club, Smithfield Shows have been of great benefit to breeders, as these exhibitions have brought out the potentialities of cattle under proper feeding. Breeders, not only in this country but also abroad, are greatly interested in the result of the competitions. The weights and ages of the animals are published. These records help the farmer in the regulation of food. This important point is further emphasised by the carcass competitions. In a notable instance an animal under three years old weighed one ton.

In former days, cattle of 5 or 6 years old were shown and then fattened. These were unquestionably enormous beasts, but the quality of the flesh was far below the present standard. Nowadays such a policy does not pay; farmers require a far quicker return for their labour and money. In like manner lambs fetch better prices than wethers, and the tendency is towards early maturity. There used to be a class for pigs under 9 months and another for those under 12 months; now the classes are for pigs under 6 and under 9 months old. With proper feeding a pig can be got quite heavy enough in 9 months

at the outside. For instance, a pen of two pigs, prize winners, at 7 months 6 days old weighed 7 cwt. 2 lb.

The prizes to be offered at the 1920 Show amount to £4,594. It is possible for a steer or ox to win prizes to the value of £250; a heifer may win a like sum; a pen of three long-woolled sheep, £110; a pen of three short-woolled sheep, equal; a pen of pigs, £55, or a single pig, £10. Encouragement in the form of prizes is not limited to exhibitors; it is announced that the herdsman, shepherd or pig-feeder who tended stock gaining the first prize in each class will be presented with a sovereign and a framed diploma bearing a suitable inscription. Silver medals will also be presented to the herdsman, shepherd or pig-feeder who fed and attended the best beast, the best pen of sheep and the best pen of pigs in the show.

At the Smithfield Show for 1920 there will also be shown an extensive and varied collection of agricultural implements, including machines by most of the leading manufacturers.

AN important conference for furthering the movement for the brightening and improvement of rural life by the provision of centres for recreation and instruction was held by the Village Clubs Association in London recently. The Chair was taken by the Earl of Shaftesbury, K.P., President, who described the aims of the Association. He remarked that in the past the townsfolk had been the spoilt children of social reformers. It was now essential to bring the country into line with the towns, and to give similar advantages to the rural population. There was great need to lighten the burden of life after a long day's work on the land.

**Village Clubs
Association
Conference.**

The first paper, entitled "The Village Club Movement and its Significance," was read by Sir Henry Rew, K.C.B. (Chairman of the Association), who said that the question of the village was an aspect of the agricultural question. It might be said indeed to be the same question, for if the village depended upon agriculture it was equally true that agriculture depended upon the village.

The next paper, entitled "The Intellectual Demands of the Villagers," was by Mr. A. W. Ashby (Institute for Research in Agricultural Economics, Oxford. Dealing with the question of

the migration of villagers to the towns, the paper stated that the agriculture of a settled country never expands rapidly enough to absorb all the natural increase in the agricultural population, and that although improvements in conditions should lead to our agriculture absorbing the whole of the coming generation, the current of migration must start again later, and be stronger than before.

“The Recreational Demands of the Villages,” was dealt with by Major David Davies, M.P., who stated that higher wages, and even a direct interest in the produce of the soil, might not be sufficient to attract and keep permanently on the land a strong and virile population. He added that the need for recreation had now been recognised by the Farmers’ Union and kindred organisations.

“The Organisation of the Village Community,” was the subject of a paper read by Mr. J. Nugent Harris (Chief Organiser of the Village Clubs Association). Mr. Harris remarked that if it was desired to keep an honest, enterprising, educated and industrious class of people on the land, those who lived on it must be contented with their community life. The Village Club movement would help materially in this respect by bringing the people together and helping them to realise that their interests are identical. Examples of the good results following the formation of a club on V.C.A. lines in various villages in different counties were given.

A discussion followed each paper. Mr. E. W. Langford, President of the National Farmers’ Union, warmly supported the movement, and said it was doing work of national importance. The N.F.U. would do everything in its power to further the objects the Association had in view. Mr. Walter Smith, M.P., and Mr. George Dallas, of the National Union of Agricultural Workers, also gave unstinted praise to the work the V.C.A. was accomplishing, and claimed that it was meeting an urgent need in our village life. Further testimony as to the value and need of the work was borne by Lady Denman, President of the National Federation of Women’s Institutes, Lord Bledisloe, Mr. J. M. Ramsay, Scottish Board of Agriculture, Mrs. Sanderson Furniss (Ruskin College), Mr. F. D. Acland, M.P., Sir John Green, Miss Lena Ashwell, Sir Douglas Newton and others.

Lord Lee of Fareham, Minister of Agriculture, expressed the deepest interest in and sympathy with this movement,

which was of immense value, and indeed a necessity. To one who was specially concerned with the development of agriculture, with a view to increased production and increased national safety, the problems of attracting labour to the land and of keeping it there were of serious import. Unless the conditions of rural life were made much more tolerable and attractive, it would be impossible to persuade the new and more intelligent class of labour to remain. Among agricultural labourers the War had created a general discontent with the old conditions of rural life, and had aroused a very proper aspiration for wider vision and larger opportunities of thought and instruction. There was likewise something akin to a revolt on the part of the wives against the intolerable dullness of the old village life. This new spirit, and the movement which sought to give effect to it, called for whole-hearted co-operative effort on the part of all classes of the rural community.

THE urgent question of housing and of building construction generally is one with which the small holder is vitally concerned, and to supply his needs steps are being taken by County Councils to ascertain the most economic and efficient means of construction.

**The Equipment of
Small Holdings:
Cottage Planning.**

A comprehensive body of information on the subject has recently been issued by the Ministry in its "Manual for the Guidance of County Councils and their Architects in the Equipment of Small Holdings."* The Manual is divided into two parts: (1) The Planning and Construction of Cottages, and (2) The Planning and Construction of Farm Buildings.

The object of this note is to review briefly that part of the work which deals specially with the country cottage. The intention of the plans set forth is to illustrate the recommendations made and to establish a general standard of convenient planning and stimulate operations consistent with the building traditions of England and Wales. Owing to the abnormally high cost of building at the present time and the need for economy, such a practical guide should be welcomed by all those whose office or profession requires them to face building

* Obtainable from H.M. Stationery Office, Imperial House, Kingsway, London, W.C.2, price 1s. 6d. net.

problems. The Ministry is satisfied that without excessive cost, but by good design, which in a cottage means right proportions and a wise use of materials, the new homesteads may be made both substantial in construction and pleasing in appearance.

Architects employed by Councils are recommended to study very carefully the special conditions of different localities where building is proposed, and so to draft their specifications as to avoid unnecessary expense through specifying rigidly certain materials or treatments when satisfactory and less costly alternatives may be found. It is not considered advisable to impose upon builders any standard form of contract. In many districts it is difficult to obtain satisfactory inclusive tenders for the execution of work on small holdings. It may be a better plan to adopt a form of building contract under which the builder tenders a fixed sum for his services, supervision, use of plant and profit, the ascertained cost of materials and labour, including insurance, being paid separately by the employer. Such a contract would obviate any re-adjustment of conditions which might otherwise be required, owing to recognised advances of the cost of labour and materials as the work proceeds. A form of contract in outline, as circulated to County Councils in October, 1919, is no longer to be had, but another form, circulated to County Councils on 30th March, 1920, provides for a fixed profit to the builder, calculated on a percentage of the prime cost of the work as agreed at the outset, with the addition of bonus to the builder in the shape of a proportion of any saving effected by him on the agreed prime cost. A form of contract prepared on this basis can be supplied by the Ministry for the information and assistance of County Councils. Variations to suit local or particular circumstances should be made in consultation with the Council's Legal Adviser.

General instructions are given as to questions of site and disposition. In the case of a newly created group of small holdings there will usually be greater freedom in the choice of sites, both for houses and buildings, than can be the case on, say, an isolated 10-acre farm. Questions of general policy must be carefully considered and the rival merits of various dispositions and groupings nicely weighed. Very often in choosing the lay-out of an estate for small holdings, regard is paid only to the agricultural aspects of the scheme, the possibilities of any grouping of cottages and buildings being

entirely neglected. If the architectural problem is considered at the same time as the division of the land, some architectural advantage may be obtained without any detriment to purely agricultural requirements. The grouping of buildings should tend to a saving in the cost of building by simplifying the work of supervision and by reducing the cost of the cottages. The possibilities of centralising the arrangements for water supply, drainage and lighting may also offer a means of reducing cost. A principle now, by the process of trial and error, is that the buildings of small holders should as far as possible be grouped together in neighbourly fashion and not dotted about as isolated unsociable units. At the same time it is to be remembered that against the amenities of centralisation must be balanced the natural desire of the cultivator to live close to his steading and his land, and dispositions should be made that will give the highest common measure of both social and agricultural advantages. Under social advantages are counted the presence of near neighbours, in case of illness or other emergency; possibility of co-operative road transport; post, telephonic shopping and other facilities, as well as opportunities of general social intercourse and the exchange of ideas. Another factor to be considered is greater accessibility to outside influence, for example, by lecturers, agricultural and other.

In choosing sites for cottages important points to be considered are sound foundations, good water supply and convenient drainage. These conditions are most frequently satisfied by a gently sloping hillside. Shelter should be sought from the usually prevailing winds or very infrequent, but searching, north-east gales, or both. This must be obtained by the wise use of natural cover, trees and local accidents to the ground. As a rule adequate shelter can be obtained by the careful grouping of the buildings and by the judicious use of trees and hedges. The maximum of sunlight should always be sought for all rooms except the larder and dairy. In planning each apartment the normal daily life of the inmates must be kept continually in mind. It is desirable that a bedroom should have an eastward window and that the parlour should face the west. If the living-room can command the path of the sun from dawn to dusk, so much the better. A general southward aspect is usually considered the ideal. Sunlight, although very important, is not everything, and care should be taken in arranging the general outlook of the

principal rooms. Successful and well-balanced compromise is the test of group-planning, allowing scope for unlimited ingenuity in the search for ideal solutions to the ever-varying problems presented by cottage-design.

Recent experiments have shown that old methods may be revived with advantage. Among these are building in chalk, cobb and pisé, methods that may help to solve the increasingly difficult problems of transport. These old processes were in former years restricted to the less accessible parts of the country, but now that transport and brick production have become such serious problems in all housing schemes, a general revival of interest in such regional materials and methods would seem to be inevitable. Experimental cottages in chalk and pisé have been built on the Ministry's Farm Settlement, at Amesbury, Wiltshire. An account of this work was published in the issue of this *Journal* for September last.

The general rules for cottage construction indicate that plain, well-proportioned elevations, a simple roof and straightforward planning are more suitable for a small holder's house than any attempts at the picturesque by means of calculated irregularities. The Ministry will not approve any design which indicates that there has been any attempt to secure elegance at the expense of utility. Unless there is any good reason to the contrary a plain rectangular plan should be the aim, neither so square as to necessitate an elaborate, heavy and wasteful roof, nor so attenuated as to be cold, and extravagant through excess of outside walling. Cottages in pairs are not only warmer and less expensive than when erected singly, but they are also more seemly in appearance. Every excrescence or corner, either external or internal, costs money, and should therefore be avoided unless some corresponding advantage is gained by its introduction. The roof should be unbroken, as every departure from a plain, lid-like form involves extra expense in construction and upkeep. Gutters, valleys, flats, and breaks generally should be reduced to a minimum.

The Manual gives schedules for three types of cottages. The first, for a self-supporting small holding of from 10 to 50 acres, contains a parlour, living-room or kitchen, scullery, larder or pantry and three bedrooms. A similar arrangement with a somewhat smaller floor area is recommended for small holdings of from 1 to 10 acres. For cottage holdings of from 1 to 5 acres the parlour may be omitted, the living-room or

kitchen having the same floor area, that is 180 square feet, as in the first schedule. It is recommended that the height of the ground-floor rooms should be kept at 8 ft. from the floor to the ceiling, and this measurement may very well be reduced by a further 6 ins. Greater heights are disproportionate to the other dimensions of cottage rooms, and the space above the window-head only acts as a trap for vitiated air. Were it not for the urgent need for economy the Ministry would insist on parlours being provided in all cottages. This room, with its innumerable functions—reception-room, study, nursery, sick-room, &c.—should be made as comfortable and as attractive as may be. It need not be large, 120 super feet, prescribed in the standard schedule being the maximum allowance. The door should preferably open off the front room and should be as far from the fireplace as the exigencies of the plan permit. As already mentioned, it is desirable that the parlour window should open towards the afternoon sun. The Manual contains detailed plans of cottages of the three scheduled types, and in every case the suggestions show an excellent combination of utility with simple elegance.

A REPORT on the work of the Ministry in connection with outbreaks of diseases among animals during 1919 has recently been issued.* The figures of outbreaks **Diseases in Animals during 1919.** given show that in 1919 the country was affected by disease to a greater extent than usual, Foot-and-Mouth Disease and Rabies being especially prevalent. The existence of these diseases necessitated the imposition of severe restrictions on the movement of animals in infected areas, and the former disease caused the loss of a considerable number of cattle, sheep, and pigs. These two diseases naturally receive principal attention, but Swine Fever, Glanders, Anthrax, Sheep Scab and Parasitic Mange all come under review as being diseases notifiable to the Ministry under the Diseases of Animals Acts. The Report also contains a brief account of the work done during the year at the Ministry's Cattle Testing Station at Pirbright and at the Veterinary Laboratory at New Haw, Weybridge, and in connection with the administration of legislation respecting the exportation of horses, the importation of dogs, and the landing of cattle

* Annual Reports of Proceedings under the Diseases of Animals Acts, the Markets and Fairs (Weighing of Cattle) Acts, &c., for the Year 1919. London: H.M. Stationery Office, 1920, price 1s. net, excluding postage.

from Ireland. A list of Orders made during 1919 under the Diseases of Animals Acts and detailed statistical tables of the outbreaks of diseases among animals are given as Appendices.

In all 84 outbreaks of *Foot-and-Mouth Disease* were recorded during 1919; the principal areas of infection were: Isle of Wight 27 infected premises, Yorkshire 20 infected premises, Kent 7 infected premises, Lincoln 6 infected premises and Warwick 9 infected premises. Slaughter of 3,938 animals in the affected districts was necessary to prevent the spread of infection, viz., 1,625 cattle, 1,541 sheep and 772 pigs. Those interested in the problem of the entry of *Foot-and-Mouth Disease* into the country will find in the Report a new contribution to the subject, entitled "The Question of Invasion."

The existence of *Rabies* was confirmed in 143 cases (140 dogs, 2 horses and 1 pig), as compared with 112 in the previous year. It will be recalled that the initial outbreak occurred at Plymouth in August, 1918. The number of persons bitten by animals in the Scheduled Areas in 1919 was 179, 46 of whom were bitten by animals proved to be rabid. There were no deaths from hydrophobia. An interesting feature of the Report is a section describing the work on the diagnosis of *Rabies*.

The number of cases of *Swine Fever* reported during 1919 was 10,359, as compared with 10,203 in 1918 and 10,261 in 1917. The existence of disease was confirmed in 2,317 cases (23 per cent. of the reported cases), the outbreaks during the two previous years being 1,407 (14 per cent. of reported cases) in 1918, and 2,104 (20 per cent. of reported cases) in 1917.

Outbreaks of *Glanders* occurred among civilian horses in 25 cases, all of which occurred in England. Of these 11 occurred in the London area, 10 in London and one in Middlesex. The remaining 14 outbreaks were distributed as follows: 1 in each of the counties of Derby, Gloucester, Hertford, Leicester, Somerset, Surrey, Warwick, the North Riding of Yorkshire and the West Riding of Yorkshire, 2 in Wiltshire and 3 in Staffordshire.

The Report states that as this disease is now approaching the point of eradication, it is proposed to extend slightly the powers conferred on Local Authorities with a view to expediting its disappearance. It is also suggested that more complete control against introduction of *Glanders* from abroad by imported horses will be necessary.

Reports were received during 1919 in relation to 1,731

suspected outbreaks of *Anthrax*, of which 239 were confirmed by tests for diagnosis at the Laboratory—180 in England and 59 in Scotland. These outbreaks occurred on 221 premises. No outbreak has been recorded in Wales during three successive years.

The number and species of animals affected were: cattle 275; horses 8; sheep 1; pigs 38; total 322, or 1.03 animals per outbreak. One dog and 7 ferrets also became affected.

The disease occurred twice on 9 premises, three times on 2 premises and six times on 1 premises. In other words, in 18 outbreaks on 12 premises disease may have arisen from a previous case in the same year. In all, 60 outbreaks (25 per cent.) occurred on premises on which *Anthrax* was known to have occurred in previous years.

The report mentions that it is rather remarkable that the outbreaks in England, which fell steadily during the War from 294 in 1915 to 153 in 1918, increased by 27 in 1919. This is probably due to the revival of trade in imported hides and feeding stuffs, the former being largely responsible for the contamination of the latter with anthrax spores in transit. On the other hand, the decline in Scotland has continued from 262 in 1915 to 93 in 1918, with a further decline of 34 in 1919.

The number of outbreaks of *Sheep Scab* in Great Britain during the year was 442. This number includes the affected sheep isolated on the premises of 145 crofters in the County of Inverness. These cases were amalgamated in outbreaks included in the returns for that county on account of the sheep using common grazing grounds.

The 442 outbreaks were distributed as follows:—England 245; Wales 70; and Scotland 127. The outbreaks occurred in 35 counties in England, 9 in Wales and 20 in Scotland.

As regards the English counties, 39 outbreaks occurred in Kent, which had been free from *Sheep Scab* for a considerable number of years, and 23 occurred in Sussex, an increase of 22 over the previous year.

The Chief Veterinary Officer of the Ministry states in the Report that the time has more than arrived when it should be made clear to sheep farmers that the statutory general dipping of sheep, which is a single dipping, is not a help but a serious hindrance to the eradication of scab. No policy of dipping aimed against scab can be expected to be successful as regards its specific object unless it comprises two dippings with an interval of not more than 14 days, preferably 10 days,

between each dipping. An extension of this interval is contrary to our knowledge of the life history and physical properties of the parasite and its eggs. Several dipping agents can be reasonably relied upon to kill the parasites of scab, but the eggs are resistant to such agents, and they may hatch out after one dipping, only to start the disease over again. If, however, there are two dippings, and the interval between is as above mentioned, the second dipping may be expected to destroy the parasites hatched out after the first dipping before they are ready to lay eggs for another brood.

The single statutory dipping has been a hindrance to the eradication of scab inasmuch as it has had the effect of hiding the visible symptoms of the disease for long periods, giving a sense of false security as regards sheep purchased. Such sheep have only too often passed from the latent to the visible stage, and have been the origin of outbreaks in the flocks of others who have bought them, believing them to be free from infection. Sheep bought at Perth, for example, have caused serious outbreaks in the South of England. It may surprise those who support a policy of single dipping to learn that practically every outbreak of scab which has occurred since the policy of single dipping was introduced as a concession to the views of sheep owners, has arisen from sheep which had been dipped once, or twice with a long interval, during the previous six months. No policy which does not involve double dipping can be regarded as an anti-scab measure. This does not mean that it is necessary to subject all the sheep in the country to double dipping in order to eradicate sheep scab. Such a policy would defeat itself by being excessive, since the areas in which no disease is known are much in excess of those in which it is known or seriously suspected of lurking. It does mean, however, that for purposes of eradication, Sheep Scab must be rigorously attacked in its lurking places, and that any measures which are based upon one dipping, or multiple dippings with long intervals are, as regards Sheep Scab, a waste of effort and money, and are foredoomed to failure.

In the circumstances it would seem advisable that the Ministry should dissociate itself from measures against Sheep Scab which have for their basis a single dipping.

With regard to *Parasitic Mange* it is pointed out that owing to the War the Parasitic Mange Order of 1911 was suspended in August, 1914, until March, 1915, and that it has been

difficult as yet to overtake the strides made by the disease during the suspension of the Order. The total number of outbreaks in Great Britain during 1919 was 5,003 as compared with 4,483, 2,614 and 2,147 respectively, in the years 1918, 1917 and 1916. There has thus been a marked increase in the spread of the disease, which is very prevalent in large towns.

In 1919, although Parasitic Mange existed in all the counties of England, there was a decrease in the number of outbreaks in 21 counties, and no change in two counties, as compared with the returns for 1918, in which year all counties except four, and one free from disease, recorded increased numbers of outbreaks in comparison with 1917. The successful suppression of mange depends almost entirely on the effort of horse owners, but it is to be feared that a good many of them are not giving the matter the attention it deserves. General administrative measures, however, of a more drastic character, may have to be adopted if the individual efforts of horse owners fail to improve the position.

From time to time reports reach the Ministry of cases of animals that have been poisoned from eating yew. The

**Poisoning of Live
Stock by Yew.**

details of one of the most recent reports may therefore prove interesting to farmers and others concerned with the care of live stock. The case in question was reported in August last from Surrey. It appears that at a farm in the Oxted Division one cow died on the 8th August, another on the 14th, a third on the 17th, a fourth on the 21st, a fifth on the 22nd, a sixth on the 23rd and a seventh on the 26th. A few days before they died all these seven cows went off their feed and appeared to be suffering from cold. There were twenty-nine cows on the farm, and the latest addition to the herd was made on 2nd October, 1919. The contents of the stomach of the cow that died on 21st August were forwarded to the Veterinary College, Camden Town, for analysis, and the Professor of Chemistry at that College gave it as his opinion that death had been caused by yew poisoning. It has been ascertained that yew trees abound in the places where all the cattle grazed. Since the Professor pronounced his opinion measures have been taken to prevent the remaining cattle having access to the yew trees. Yew (*Taxus baccata*, L.) is the only British conifer likely

to prove poisonous to live stock in any serious degree. The tree has unfortunately been a frequent cause of fatal poisoning to horses and cattle, and many cases resulting from the animals eating fresh foliage direct from the trees are on record. The bark, leaves and seed are all poisonous, and the leaves are the part usually eaten. Old leaves and shoots are the most poisonous parts, and stock are perhaps more likely to eat the dark green foliage of the yew in winter or during a scarcity of green fodder than at any other time.

Experiments made with autumn and winter leaves indicate that the quantities necessary to kill animals may range from 0.2 lb. per 100 lb. live weight in the case of a horse to 1 lb. per 100 lb. live weight in the case of cows and sheep, but naturally the figures obtained by experiments in this connection vary. Investigations point to the alkaloid *Taxine* as being the toxic substance, although it is doubtful whether this is the only poison present. *Taxine* has a bitter taste, is a heart depressant and may cause death from suffocation. Yew also contains a considerable quantity of formic acid and the irritant volatile oil of yew. The yew is irritant and narcotic, and the poison is not cumulative but rapidly effective, so that in certain cases animals may die suddenly without any previous symptoms having been observed.

When yew hedges and yew trees are clipped it is desirable that the clippings should be removed out of reach of any stock that may be grazing in the vicinity, as otherwise they are liable to be eaten, with the consequences indicated above.

By the terms of an Order recently made by the Department of Agriculture and Technical Instruction for Ireland, which

**Importation of
Potatoes
into Ireland.**

came into operation on the 15th November, no potatoes may be imported into Ireland from any country except under licence to be obtained by the consignee in Ireland.

Every consignment of potatoes imported must be accompanied by a declaration of the sender in a prescribed form. Forms of application for licences and forms of declaration can be obtained on application to the Department at Upper Merrion Street, Dublin.

Potatoes grown in England and Wales will only be permitted to enter Ireland if a certificate has been issued by the

Ministry, not more than nine months previously, that the potatoes were grown on land which is not situated within a Wart Disease Infected Area and which is not within one mile of any land on which an outbreak of wart disease has occurred. In addition, if the potatoes are of a variety approved as immune from wart disease, they must have been inspected while growing and certified by the Ministry as true to type. The reference numbers of the certificates issued by the Ministry must be quoted by the sender on the form of declaration. Applications for the Ministry's certificate should be accompanied by a declaration signed by the actual grower, stating the variety of the potatoes and the place where they were grown, and declaring that no outbreak of wart disease has occurred thereon.

UNTIL 1st March, 1920, plants and flowers in pots could be conveyed at company's risk or owner's risk, at full parcels scale or owner's risk scale respectively, without any special protection.

**New Railway
Regulations for
Conveyance of
Plants and Flowers.**

Notice was given by the Railway Authorities to the horticultural trade that the conditions under which they had been consigning their traffic had been completely cancelled and that, from 1st March, plants and flowers in soil, other than in truck loads, could only be accepted if packed in substantial crates or wooden boxes admitting of traffic being loaded on the top.

In the majority of cases this drastic change would undoubtedly have had the effect of killing the trade altogether, owing to the high cost of crates or boxes. The question was accordingly taken up by the Ministry, and through its intervention the operation of the revised regulation was postponed, on the understanding that a meeting should be convened by the Ministry to give the Railway Companies and the trade an opportunity of ascertaining whether, without the imposition of a prohibitive charge, a reasonable alternative course could be found. Two conferences were held. The Ministry put forward a suggestion to the effect that the difficulty could be overcome by the adoption of two alternative rates for the traffic, one to be applicable to plants packed in the customary manner, while the other and lower rate should apply to plants packed in accordance with the Companies' new regulations.

At a meeting on 31st August, at which representatives of the railways and the trades concerned were present, this proposal was agreed in principle, and subsequently the Railway Clearing House, after further consultation with the trade, decided that from 1st November, 1920, flowers and plants in soil, or in pots, when conveyed in the guard's van by passenger train, will be charged as follows:—

	<i>Company's Risk.</i>	<i>Owner's Risk.</i>
(a) Packed in substantial crates or wooden boxes so constructed as to admit of other traffic being loaded on top thereof.	General parcels scale, including collection and delivery.	Owner's risk scale, including delivery.
(b) When not so packed :—		
1 foot or under in height.	General parcels scale plus 50 per cent., including collection and delivery.	General parcels scale, including delivery.
Above 1 foot in height.	General parcels scale plus 25 per cent., including collection and delivery.	Owner's risk scale plus 25 per cent., including delivery.

In the case of traffic conveyed under Clause (b) above, prior arrangements must be made with the Railway Companies as to the quantity which can be accepted for forwarding, when such traffic exceeds one cwt.

The above rates will supersede any existing special rates.

THE Ministry has received numerous representations to the effect that in many boroughs and urban districts Councils have not satisfied the outstanding demand for allotments and, when pressed by the applicants, have stated that they are unable to acquire land, owing to the owners being unwilling to let and to all available land being either building land or having a prospective building value. Councils have stated that, in such circumstances, they cannot acquire land at a price or rent sufficiently low to enable them to let allotments without incurring loss. It seems to the Ministry that the position taken up by such Councils is based on a misconception of the provisions of the Small Holdings and Allotments Acts, 1908 to 1919, with regard to the compulsory hiring of land for allotments.

A Council can make an order authorising them to hire land compulsorily for a period of not less than 14 years and not more

than 85 years. The amount of the rent will be fixed in default of agreement by an arbitrator, who is required to take into consideration the rent (if any) at which the land has been let, the annual value at which it is assessed for income tax or rating, the loss (if any) caused to the owner by severance, and the terms and conditions of the hiring, *but he may not make any allowance in respect of any use to which the land might otherwise be put by the owner during the term of hiring, being a use in respect of which the owner is entitled to resume possession—i.e., building, mining or other industrial purposes, or for roads necessary therefor.* (See paragraph (4) of Part 2 of the First Schedule to the Act of 1908 and Section 46 of that Act.)

The compulsory hiring provisions of the Acts enable a Council therefore to obtain a tenancy of land which can be renewed by the Council without the owner's consent, at a fair rent fixed without regard to any immediate or prospective value which the land may possess for building, mining or other industrial purposes, but subject to the landlord's right of resumption if he satisfies the Ministry that he requires the land for such purposes. The Act of 1908 as amended by the Act of 1919 enables the notice of resumption to be such as is prescribed by the Hiring Order, but so as not to require a longer notice than twelve months.

The Ministry understands that in some cases Councils have hesitated to use their compulsory hiring powers on the ground of expense. The expenses incidental to the compulsory acquisition by hiring need not be considerable, and when the land is acquired all such expenses can, if so desired, be borrowed by the Council and can be recouped during the period of the lease by a very small increase of the allotment rents. Councils have been urged, therefore, to take immediate steps to hire land, if necessary compulsorily, to satisfy the requirements of applicants where an unsatisfied demand exists.

The Ministry regards the encouragement of the allotment movement as a matter of the most urgent national importance, not only from the point of view of the maintenance, and possibly the increase, of food production, but also on account of the social and economic advantages of the movement. Allotments provide healthy and profitable occupation, create a spirit of co-operation and goodwill, and do much to allay industrial unrest and disturbance.

THE Ministry gives notice that a Show of Thoroughbred Stallions will be held in conjunction with the Hunters' Improvement and National Light Horse Breeding Society at the Royal Agricultural Hall, Islington, on 22nd, 23rd and 24th February, 1921. A Challenge Cup, presented by His Majesty the King, will be awarded for the Champion Stallion in the Show; and a Gold Medal will be awarded by the Ministry to the owner. Sixty King's Premiums (including twelve Super-Premiums) will also be offered for award by the Ministry on conditions similar to those which obtained at the Show held in March last.

The average value of a King's Premium, paid by the Ministry, is £350, and the average earnings of a stallion £410. The twelve Super-Premiums carry an additional value of £100 each.

After the routes of the King's Premium Stallions have been settled, a limited number of Ministry's Premiums will be available for award. The average value of these Premiums, paid by the Ministry, is £200, and the average earnings of a stallion £270.

Forms of entry for the Show may be obtained shortly from the Offices of the Ministry, Whitehall Place, London, S.W.1. The last date for the receipt of entries is 17th January, or for post entries 24th January.

No entry will be considered in respect of a stallion unless licensed under the Horsebreeding Act, 1918, for the 1921 season. Applications for such licences can now be made to the Ministry.

SPEECH BY THE MINISTER OF AGRICULTURE AT LEICESTER.

THE following is the text of a speech by The Lord Lee of Fareham, Minister of Agriculture and Fisheries, at the de Montfort Hall, Leicester, on Saturday, 16th October, 1920 :—

LORD LEE : Mr. Chairman, Ladies and Gentlemen, I am afraid it is some months since I last had an opportunity of addressing a meeting of agriculturists. That has been due partly to reasons over which I have had no control and partly to the fact that I know that, during the harvest season at any rate, farmers have something better to do than to be attending afternoon meetings listening to words however wise, or however foolish, or, at any rate, however eloquent. I know they have been very much better employed. To-day, however, I am delighted to have this opportunity of meeting so large and representative a gathering, not merely of farmers, not merely of landowners, not merely of labourers, but a gathering representing, as I believe it does fairly, the agricultural industry as a whole. (Hear, hear.)

The Ministry of Agriculture: Misconceptions as to its Functions.—The first point that I want to make is that the Ministry of Agriculture is concerned with the interests of the industry as a whole, that it has no preferences or prejudices as between this or that section of the agricultural community. It is anxious to help them all, so far as it can, because it knows, as you must know, that each section is absolutely indispensable to the others. I particularly resent the suggestion, because it is grossly untrue, that the Ministry, whenever it takes some action which may not commend itself to this or that section, is showing an undue preference; that it is throwing its weight in favour of one section as against another, either in its administrative acts or in the legislation which it is its business to introduce. I am sure charges such as those are due, in almost every case, to a genuine misunderstanding as to what the true functions of the Ministry of Agriculture are, and what its relations to the industry should be. In my experience there are two common but quite opposite misconceptions as to the duties of the Ministry of Agriculture. The first of them is that the Ministry wants, in some way or another, to direct and control the whole of your business, and to do that by means of interference by what is commonly called, I think, an "army of inspectors from Whitehall." Apart from the fact that we have no accommodation for

an army of inspectors or anything else in Whitehall—the Ministry of Agriculture is a shockingly overcrowded establishment—that is not our desire in the least. Then there is the other misconception, rather the opposite one, that it is the main business of the Ministry of Agriculture to be always trying to wring concessions of some kind or another, for farmers in particular, out of a reluctant Cabinet and Parliament, and whilst it is very seldom thanked if it is successful in those matters it is as invariably abused if it happens to be unsuccessful. My conception of the functions of the Ministry of Agriculture is entirely different. I do not think it should be either a controller or a wet nurse of British agriculture. It is true it is its representative in the Government, its spokesman in Parliament, and I hope when occasion demands it will try to be its big brother in both those bodies.

Disappearance of Control.—But to go back to the first point, it is certainly not the desire of the Ministry, so far as I have anything to do with it, to exercise undue control; indeed my ambition, since I have been there, has been to try and get rid, at the earliest possible moment, of all the controls of prices which were exercised and which were necessary during the period of the War and the period that immediately followed. (Cheers.) I claim that I have been largely successful in the pursuance of that policy. Anyhow I have done my best, but I must point out quite frankly that I have not always been helped by farmers with regard to this matter. There have been notable instances, for example, with regard to home-grown meat, where I have been opposed, and in the end practically voted down by the farmers themselves. One of the unhappy results of years of control during the War has been that it has made some farmers hug their chains in the belief that if they were removed they would not be as comfortable as before.

Wheat Prices.—Every one of those controls has now gone, with the exception, and I believe it is the sole exception, of the price of wheat in connection with the harvest of 1920. So far as next year's harvest is concerned a guarantee has already been given by the Government that there shall be a free market. I am well aware—if nothing else, my postbag would remind me constantly of the fact—that it is a very sore point with farmers at the present time that they are not allowed a free market for their wheat of the present harvest, and I am inclined to sympathise with them. I do not mind saying that I have done my best to get that view considered by the Government, but neither the Minister of Agriculture, nor any other Minister, can expect

to have his own way in everything that he thinks is right for the particular industry which he represents, because very often there are other considerations far more serious to the nation than even the rights or the prosperity of a particular industry, even of an industry so important as agriculture. At the present moment we are faced with a rise in the price of the loaf, at a time of industrial unrest, which has come to a most disastrous point to-day in the launching of this coal strike. There are dangers ahead of us this winter so grave that every man must be prepared, so far as he is able, to sink his own personal interest, and the interest of his pocket, if thereby he can better safeguard the interests of the nation. I am convinced that in these matters one never appeals to the patriotism of the agricultural community in vain. They have rendered services, not only during the War, but in every crisis of the country's history, which have been at least equal to those of any other section of the community. I know if they are asked to be patient with regard to this matter the appeal will not be made to deaf ears. I would ask them also, in their own selfish interest, to consider this, that if at the same moment that it has become necessary for a rise in the price of the loaf to take place, it were announced that an additional price was to be given to farmers for their wheat this year, over and above that which was promised, and which was the basis of an understanding six months ago, I believe there would be an outcry, and an amount of industrial unrest which would do far more harm to the farming industry in the long run, and to the position of farmers generally, than they would gain from the small financial benefit which they would get at the moment. But that does not alter my view that these controls of prices are bad for production, and it is because they are bad for production that I have opposed them, and done my best to get rid of them at the earliest possible moment. It is quite clear, and after all it is only the economic law, that controls of this kind result in short supply. De-control, on the other hand, means stimulus to production. We have seen that again and again, and I believe it is practically a law of nature. The policy, or the principle, which I have been pressing upon the Government and Parliament during the time that I have been at the Ministry of Agriculture, has been practically this, that "free conditions breed enterprise." That is what the farming industry needs more than anything else in the world.

Control of Bad Farming.—So far as I am concerned, the only control that I want to see retained, and that I shall fight to

retain, is what is commonly called the control of the bad farmer. (Hear, hear.) I have never found in any meeting of farmers that that was an unpopular proposal. No one likes the black sheep in his own flock. I know I shall have the support of the entire farming community behind me in that. May I say this in the presence of the two principal officers of the Farmers' Union: a great temptation in one sense was put in their way when the Agriculture Bill was going through Committee in the House of Commons, and the control of cultivation was so whittled down as to be practically worthless. They stood to their guns, however, and said: We recognise it is fair that we should submit to control if we get the benefits and guarantees provided by the Bill. I think that was a fine example of straight dealing and courageous leading. With regard, however, to this question of control of bad farming, let me assure you that I have no desire whatever that it should be exercised from Whitehall by this "army of inspectors" who come down from London in express trains and tell the farmers of Leicestershire how they ought to run their business! That is not what is wanted, and certainly it is not going to be done. As you know, the County Agricultural Committees have now been reconstituted. They consist of representative local men, and in most cases every agricultural interest is admirably represented upon them. The bad farmer will be judged, not by an inspector from Whitehall, but by his neighbours and by practical men in his own district. Surely there can be nothing fairer than that.

Farming not a Depressed Industry.—Then may I say a word about what I call the second misconception as to the duties of the Ministry, one which is perhaps more widespread, and certainly equally mischievous. In my view British agriculture to-day is neither a helpless babe wanting a nurse, nor is it a spoilt child waiting to be bribed. I am convinced that farmers do not need spoon-feeding in the conduct of their business, and, therefore, the Ministry is not to be judged by the amount that it does for them in those respects, or by the number of concessions, so called, which it manages to wring from the Government on their behalf. Farming to-day is not a depressed industry, and it is very unwise on the part of farmers or anyone else to try and create the impression that it is. After all, we want to attract to the industry the very best men in the country; we want to attract more capital, more brains, more energy; and if for no other reason, because the nation needs increased home production. (Hear, hear.)

Need for Increased Production.—Mr. German asked me whether that really was needful at the present time. I venture to say there never was a time when it has been more needful, except possibly at the height of the submarine campaign, and as the inevitable shrinkage of production goes on all over the world, or, at any rate, in those countries upon which we have been accustomed to rely in the past, it will become more and more a matter of national necessity that we should produce the absolute maximum that is possible from our own soil at home. Therefore we want to get the best men into farming. We want to get all the capital and brains and energy that we can; and the more men of that kind that come in, and the more production there is, the more will all engaged in agriculture, in every section of the industry, prosper by it.

The Proper Functions of the Ministry.—Now, having described some of the things which it is *not* the business of the Ministry of Agriculture to do, may I touch for a few moments upon the things which I consider to be its principal business, and which I claim it is already doing. Speaking generally, it is the business of the Ministry to be the guide, philosopher and friend of all sections of the industry, and to place at their disposal every new development from research, education, and so forth, that can be discovered; to protect the industry, so far as it can, from epidemics of disease and pests; to organise it in the counties, so that its voice shall be more effective in the councils of the nation; and to defend it against unfair attacks from wheresoever they proceed; in fact, to see in these matters that it gets a fair field and no favour, which I am sure is the most that it desires. As I say, we are endeavouring to fulfil those duties, and I am not ashamed of our record up to date.

Research and Education.—The first in order of importance, without doubt, is the work which we are doing in research and education. Perhaps it will give you an idea of the great increase in that work if I tell you that the amount of money, which has now been allocated, and which we are spending every year upon agricultural research and education, is about eight times what it was just before the commencement of the War. With that money—and I venture to say we are spending it well and prudently—we are creating a network of organisations, in many cases *not* entirely new institutions, but we are establishing or subsidising centres at universities, colleges, and farm institutes, and advisory experts in the counties. They are all working together, and to one end, with the finest kind

of "team play," to give farmers and agriculture the latest and best information with regard to the developments of science. We are working up all those agencies. They are all, of course, co-ordinated under the Intelligence Department of the Ministry, which is presided over with so much distinction and ability by Sir Daniel Hall. This is not merely a policy of theory, because it is already producing very remarkable practical results. I think most of the progressive farmers in the country are aware of the wonderful work which has been done by Professor Biffen and others in producing new varieties of seed which are calculated to resist some of the risks of our climate, and to show a heavier yield. Many farmers who are not progressive are using wheat such as Little Joss, Yeoman, and so forth, without realising that the creation of those wheats is due to scientific work in the laboratory under the inspiration of the Ministry of Agriculture. Then we have initiated throughout the country—and I speak of this because sometimes I have been accused of wanting to plough up the whole of the shires and reduce Leicestershire to one brown arable area—we are devoting especial pains to the campaign for the improvement of grass lands, and it has caught on already in a most remarkable way. We have shown, and proved to the satisfaction of farmers in different parts of the country, that, by following proper methods of manuring, the productive capacity of their grass land may be trebled and even quadrupled. Then we have devoted time and thought to the development of agricultural machinery, and in that connection I have no intention of apologising for the work which the Food Production Department did during the War in importing and trying, and exposing where they were worthless, tractors of every sort and kind from every manufacturing country in the world. Although we have been accused of having spent a great deal of money, or lost it, in this matter, I venture to say we saved the farmers of this country at least twenty millions of money, and ten years of time, instead of letting them find out for themselves, at the expense of their own pockets, which machinery was reliable and which was not. Then we are conducting a great series of experiments in arable dairy farming to show what great economies may be effected with regard to feeding stuffs, which are such a serious expense at the present time, and how the production of milk may be made cheaper.

Milk Recording Scheme.—Then there is the Ministry's scheme of milk recording. I do not know whether farmers

realise the extent to which that is already benefiting the pockets of those who have come into the scheme. The scheme, I am thankful to say, is growing. Two years ago there were 20,000 registered cows; last year there were 38,000; and this year there are over 50,000. I hope the scheme will spread like wildfire. It is still in its infancy, at any rate. But apart from what it has done in the way of increasing the production of milk, the financial results have been extraordinary. I was looking only yesterday at some of the recent sales, during the last three weeks, of non-pedigree certificated cows under our recording scheme. At the first sale 62 of those non-pedigree cows sold at an average of 104 guineas apiece, simply on account of the Ministry's certificate. Three sold for over 200 guineas. At the second sale 34 cows sold at an average of 88 guineas, six of them over 100 guineas. The third sale, I think only a week ago, showed an average of 91 guineas, with nine over 100 guineas. Any farmer can see for himself what that means in gain to his pocket, and I think the Ministry may claim some credit for that.

Animal Diseases and Pests.—Then with regard to protecting the industry from epidemics of disease and pests, you are all aware that we have had a particularly anxious year with foot-and-mouth disease and rabies, and it has been the painful duty of the Ministry to exercise its powers with vigour and relentlessness in the interest of the farming community. We have, at the same time, studied the convenience of the industry as far as we could; and at any rate we have been successful more than once in stamping foot-and-mouth disease out altogether. I called this morning for the latest position, and I find that in spite of recent outbreaks there is now only one small district in the country where there is any foot-and-mouth disease left, or where there are any severe restrictions maintained, and we hope that these will all be removed, unless there is a fresh outbreak, before the end of the present month. But we are not content with stamping out the disease wherever it appears, by slaughter. For the first time I think in the history of this country we are initiating a scientific investigation, without undue regard to cost, with the determination that it shall be thorough and searching, into the nature of this pest and the means of grappling with it. I am inviting the services of the most distinguished scientists from any part of the world to come and help us. All I ask is, having set this great inquiry on foot, that there will not be any undue impatience as to the

result. These investigations take an immense amount of time; they may take years. Every country that has tried to grapple with the problem has failed so far. The task is obviously one of enormous complication and difficulty. Therefore I say it will take a long time, and I hope you will wait with patience for the result. I will not say much about our war on rats, except to remind you that the next "National rat week" is from November 1st to the 6th, and that England expects that every farmer will do his duty.

Importation of Stores: A Warning to Farmers.—In connection with this matter of cattle disease, I am, as you know, being constantly pressed by certain interests to admit store cattle from abroad, and for reasons which I regard as good and sufficient I have absolutely refused to consider making any change in the existing law.* (Hear, hear.) I am not going to argue the case here again to-day, but I want to give one solemn word of warning to farmers generally. There is, as you know, a very remarkable and regrettable falling off in our herds throughout the country; the latest returns show an almost sensational drop; and it is due very largely to the abnormal slaughter of calves that is going on throughout the country. (Hear, hear.) I am aware that there are difficulties in rearing, but this excessive slaughter is primarily the result of tempting prices for veal. I can only say that if that is continued to a point where there is a shortage of stores so great that our herds cannot be maintained, then there will grow up an irresistible, and I fear a much more justifiable, demand than there is at the present time for importation of store cattle from abroad, with all the risks that that may mean to the health and safety of our herds. Unless, therefore, this indiscriminate slaughter of calves is stopped, and unless there is more breeding and rearing, those who are with me in thinking that store cattle should not be admitted will be selling the pass and destroying their own case.

Agricultural Organisation: The New Committees.—There is only one word I want to say with regard to the new organisation of agriculture in the counties. I have great hopes for the industry, as well as for the Ministry, in these new Agricultural Committees. I am hoping that they will be the eyes and ears of the Ministry in the counties; that they, through their National Council of Agriculture, one for England and one for Wales, will have what I may call their Agricultural Parliament, and that that again will elect what I may call an

* See note in the issue of this *Journal* for last month, p. 704.

Agricultural Cabinet in the Central Advisory Council which is to be constantly at the elbow of the Minister of Agriculture, to keep him straight and in touch with the views of the farming community throughout the country. With regard to the Central Advisory Council, I am going to be bold enough to say that whilst as Minister I shall be the nominal chairman or presiding officer of that Council, I want to have as the real acting chairman a practical farmer of the highest standing and reputation amongst his own people. (Cheers.) That will, I hope, satisfy the demand for what is commonly called "a practical man in Whitehall." (Laughter.)

Recent Legislation : Seeds and Fertilisers.—Now a few words about our legislation. I have been talking to you hitherto about our administrative Acts. I have referred to the Bill which formed these County Committees, and before I come to a larger Bill I want to mention two other Bills which we passed through Parliament last Session, and which attracted very little attention, but which I think are going to be of immense service to agriculture as a whole. The first was the Seeds Bill. That is a little Bill which may have great consequences. It forbids the sale of bad seeds or weed seeds. If there is anything which is the curse of the farmer's life I believe it to be weeds, particularly during the past summer. By this Bill we are endeavouring to tackle the trouble at the right end, and that is to prevent the weeds being sown, instead of dealing with them afterwards. I do not want to go into the details of the Bill now, because it does not come into full operation until August of next year, but I venture to say that as a result of that Bill British farmers will be better protected against bad seed and weeds than any other farmers in any other country in the world. (Cheers.) The other small Bill was the Fertilisers Bill, by which we are going to maintain control of the export of fertilisers from this country. (Cheers.) In the present condition of the world that is the only way in which the supply can be maintained and prices kept down. I think that will be recognised as being a vital need for agriculture. The Ministry has further so stimulated the manufacture of artificials in this country that at the present time four times the amount of sulphate, and three times the amount of basic slag that were used before the War are being used to-day. (Cheers.) Those are important results.

The Agriculture Bill.—I am sure you will expect me before I sit down to say a few words about a much bigger Bill, and

that is the Agriculture Bill that is now before Parliament. (Cheers.) Do not suppose for a moment that I am going into a long discussion with regard to the details of the Bill. After all, I am going to have plenty of that in the course of the next few weeks. My friend, Sir Arthur Boscawen, will have it first in the House of Commons; I shall have it later in the House of Lords. I am not going to anticipate all that. I recognise—I hope my eyes are as wide open as most people's in this matter—that there is considerable difference of opinion with regard to the merits of the Bill. Some people say: "Much too severe"; others say it "does not go nearly far enough"; others say it is a "very good" Bill; others say it is "rotten"! (Laughter.) So, balancing all those things together, I am coming rapidly to the conclusion that the Bill must be just about right. (Laughter.) At any rate, I claim that it is an attempt to do evenhanded justice all round, with due regard to the necessities of the times, to the landlord, to the tenant, and the labourer alike. I do not say that it is particularly popular with any of them. If it were I should be at once accused of introducing a sectional measure. From what I have heard recently I gather that it is perhaps even less than popular with the landowners, but I can assure them that I have a very sincere desire to be fair in connection with this Bill, and if for no other reason, because the services that the landlords of this country as a class have rendered to agriculture and to the nation have been many and most striking. I venture to think that those farmers who have now acquired their own farms, and are their own landlords, are beginning to realise the truth of that statement in a way that they never realised it before. A friend of mine who purchased his holding about two years ago said sadly the other day that he was the worst landlord he had ever had. (Laughter.) Owing to the conditions of the times, and new taxation, and so forth, landlords are, in many cases, forced to sell; they cannot possibly afford to carry on; and that throws upon the Government the necessity of trying to protect the reasonable interests of the tenants, and, at any rate, to see that they have that sense of security, without which it is hopeless to suppose that they are going to show any enterprise or increase production. I say this with all seriousness and earnestness to the landowners, that although there are many things in the Bill which they may not like, I venture to think that it offers a fairer settlement than any future Parliament is likely to offer them, and that it represents the only alternative to either fixity of tenure or land nationalisa-

tion. If, in spite of this, Parliament should decide to reject the Bill, I can only say that, so far as I am concerned, I shall not introduce another, and I doubt very much whether anyone else will ever be in a position to propose such favourable terms again.

Difficulties in the Way of Retrospective Legislation.—Now a point about tenants. I hope you will agree that I am not seeking to shirk any difficult points. I know there is one difficult point, and if I do not mention it now I shall be asked about it afterwards, and that is with regard to the position of tenants whose tenancies came to an end at Michaelmas, and who wish the provisions of the Bill to be made retrospective. I have very great sympathy with those cases. I have thought a very great deal and very anxiously about them, and I have gone into all the possibilities on one side and the other. I recognise that owing to the fact that when the Bill was originally introduced we said we wished it to come into operation on September 1st, great expectations were aroused. But the discussions have taken longer than we anticipated. Other matters have come in the way, and now the Bill obviously cannot be law by September 1st last. I am not going to give any pledges, I hope it may be passed by January 1st, but certainly not before then. As a result of this delay a large number of tenants, notably in Worcestershire, have been very seriously affected by losing the protection which the Bill would have given them if it had been law by September 1st. But after all the principle of the Bill was that only tenancies which expired after the Bill was passed should reap the benefits of its provisions. We were too optimistic about the date. We could not foresee some of the delays. The House of Commons refused, perhaps very rightly, to be hurried, but the results are none the less unfortunate and hard for those particular tenants. In every situation there are hard cases, but the trouble is I do not see any practical way of dealing with this particular one. Parliament has a particular dislike of retrospective legislation; it has been tried again and again and nearly always been rejected; and I see very little hope of the House of Commons adopting a different view now. In many cases settlements have been effected with regard to these changes of tenancies, and it would be impossible now to re-open settlements which are already closed. Generally speaking, the difficulties are so great that, most regretfully, I have come to the conclusion that there is no chance of this portion of the Bill being made

retrospective. On the other hand, we are proposing to give landlords the right, if they choose, to withdraw notices which they have already given, in cases where they find that they would be unable to face the compensation which they would have to pay if the tenant was forced out.

The Position of the Bill.—I am not going into details any further. They will be threshed out almost immediately in Parliament. But I am aware of the fact that opponents of the Bill have been very busy during the Recess in working up, quite legitimately, opposition against it. It is therefore necessary to say this. The Government is determined to pass this Bill into law this year, if and so far as they have the power to persuade Parliament to do it. (Cheers.) I can tell you, on the authority of the Prime Minister himself, that he regards this Bill as almost the most important item remaining in our programme—(cheers)—that we are pledged to it up to the hilt, and we are going to leave no stone unturned in order to get it through. (Cheers.) In saying that I do not mean we are not going to be reasonable and conciliatory in debate. But at the same time we are determined, and whilst, of course, we are dependent upon Parliament, I can only say for my part, and for the Government of which I am a Member, that we are going to do our utmost to carry out that undertaking.

Profiteering Charges.—Mr. German asked me to say a word about the charges which have been launched against farmers with regard to what is commonly called profiteering. I do so very gladly, because I feel strongly on the subject. Quite apart from the fact that people who criticise, as a rule, have not the remotest conception of the heart-breaking risks and trials of farming in our climate, of the way in which the whole of a man's energies and money may be practically lost in a few days by some turn of the weather, it seems to me that this charge of profiteering directed against farmers is peculiarly unfair and ridiculous. After all, the farmer does not make his own market; he does not fix his own prices; he has no rings or combinations of his own, although he often has them against him. What does he do? He sends his produce to market, and he has to take the market price that is offered, very often at auction. Sometimes the profit is high; sometimes it is low; sometimes it is none at all; but if it is high, is it really seriously contended that he should refuse it; is it seriously contended that he should refuse a price which is offered to him openly? Apart from the fact that he would be a fool if

he did—(laughter)—it would not be the *consumer* who would benefit. If the farmer said: “No, that is really too much; oh no, I could not accept that,” it would be merely the middleman who would take the profit, and the consumer would be no better off. When I hear this talk of profiteering, and I think I have heard of it especially with regard to milk, I am struck by the fact that with regard to last winter’s milk production there was a very elaborate inquiry by the Costings Committee of the Ministry of Food, and that Costings Committee, of a Ministry which is generally supposed by farmers to be none too friendly to agriculture, reported that the average cost of production of milk last winter, taking the country as a whole, was 3s. 1½d. per gallon, whilst the average price that was paid to the farmer, taking the country as a whole, was 2s. 8d. There is a shocking case of profiteering by the farming community. (Laughter.) Of course, it is impossible to prove what may have taken place in this or that individual instance, but I am convinced that the charge of profiteering, generally speaking, is both baseless and unfair. (Cheers.) But that does not mean that we want to go to the other extreme, and say that farming is doing badly, because undoubtedly prices are better than they were, relatively, and farmers are doing better than they were before the War; and a very good job too for the nation. (Cheers.) It is about time in the national interests that farming was doing better. (Cheers.) In that connection I want once more to beg of farmers that they will not be crying wolf too often, or saying that “the outlook is black and absolutely hopeless,” or that “farming does not pay,” because, in the first place, it is not true, and, secondly, because it really does injury to the industry to which, as I say, we wish to attract the best men. Farmers grumble a good deal about the rise in cost of production, but I do not hear them boast very much about the rise in cost of produce, yet there is a little balance on the right side. And I want them to realise this, that Labour is entitled to a share of that. (Hear, hear.)

The Claims and Rights of Labour.—This is my last point. The relations of labour to production is by far the most serious problem which confronts agriculture to-day. It is a vital question; it is urgent; it is unescapable. There is no subject in the whole range of agriculture in which I am so deeply concerned and interested as the labour problem, and there is no subject with regard to which my sympathies are more deeply aroused. Farmers owe a very great deal to their skilled

labourers. (Hear, hear.) They are one of the most skilled class of workmen in any trade in any country. I believe someone said that it is much easier to replace a Cabinet Minister than it is to replace a ploughman; I accept that! (Laughter.) And, what is more, these skilled men have shown, throughout these times of trial, during the last few years especially, very little tendency to ca'canny, and very little tendency to strike. The farmers have reason to be grateful for that—(cheers)—and if they would look a little more upon these men as their partners in the industry, and would see that it is really in the interests of the employer, quite as much as that of the men, that they should be content, that they should be well paid, that they should have reasonable conditions of work and housing, it would benefit the farmers quite as much as anybody else. After all, the labourers have had a real and lifelong grievance as a class; now the sins of the fathers are being visited on the children; and there is a great deal that has to be done in order to give the labourer that full share to which he is entitled in the prosperity of the industry. As regards wages, I think that question is going to right itself by the usual process of negotiation and examination by the Wages Board; but there is one problem which is unsolved, and which, so far as I can see under present conditions, is almost insoluble, and that is the question of the "tied cottage." It is a real hardship to both sides. Tied cottages are essential for some men on the farm; and I was very glad to see that recognised frankly and fully in an article which I read in the "Land Worker," the organ of the men's Union. But if a man is turned out, if a man has to go, he must have somewhere to go, and the houses do not exist. They have got to be built, but who under present conditions can build them? Who can afford to build them? The Government is doing its best to push on with housing, but it cannot get the labour. More houses is the first and the most important need of the nation to-day, and if the Building Unions cannot deliver the goods then we have to get them in some other way. (Hear, hear.) Speaking with all due responsibility as a member of the Government, I say we are determined to have these houses. (Cheers.) This is not the time when the nation can be held up by some rigid trade union rules which will forbid even an ex-service man, who has fought for his country, from joining in the building of house in which he is going to live, because he has not been apprenticed to the trade from his youth.

There is only one other point with regard to labour. There is a certain amount of unrest amongst agricultural labourers

at the present time owing to rumours of discharges on a large scale due to a reduction of the arable area. I am not willing to believe that there is very much in that, although in some cases there may be. There are some farmers who are affected by panic, and who think, on account of the higher wages, their only safety is to put more of their land down to grass. If there is any deliberate movement of that kind, there could be nothing more dangerous or fatal to the agricultural industry. It would create an army of landless men, men who understand work on the land, and who would make an irresistible demand, with justice behind them, to have that land broken up and given to them to deal with as small holders. If farmers were led into that mistake they would be simply cutting their own throats and destroying their own position. I trust the new County Agricultural Committees will exercise a very firm hand in regard to this matter. Meanwhile I implore both masters and men to take every opportunity of getting together and discussing and understanding each other's difficulties. If only the two sides would meet more often there would, I am convinced, be a better understanding. The great danger to-day is that there is so much mutual distrust and misunderstanding that rash steps are taken which are very often irrevocable. After all, all sections of the agricultural community must work and stick together, because no one can settle their differences except themselves. The Government cannot do it; certainly the Ministry of Agriculture cannot do it. What we want to avoid at all costs is any repetition of the Holderness tragedy. If from exasperation and lack of understanding the labourers say just at harvest time to the farmer: "Now we have you by the throat and we are going to have our terms," the farmer naturally retaliates and says: "This may be harvest time but winter follows harvest." There would be retaliatory discharges and every sort of bitter feeling. All that would be unnecessary if masters and men would get closer together. Do not look to the Government; do not look to any outside tribunal in these matters; get together and thresh out your difficulties. You must always remember that neither side can prosper unless the other is reasonably prosperous also.

"Pull Together."—My final word to you is to re-echo what the Prince of Wales said on his return from his tour the other day: "Pull together."

THE ENCLOSURE OF OPEN-FIELD FARMS.

THE RIGHT HON. LORD ERNLE, M.V.O.

THE threefold division of the agricultural interests into landlord, tenant-farmer and wage-earning labourer, as well as the individual occupation and cultivation of agricultural land, are relatively recent growths in many parts of this country. As compared with the much older system of open-field farms, cultivated in common on co-operative principles by associations of occupying co-partners, they are a modern development. The change from the one to the other has been a slow but continuous process. Already in progress at least as early as the reign of Henry III, it was not completed until the first half of the nineteenth century. Even then the older system has lingered on in remote country districts. Many of us have seen it in active operation. Though now it has been completely superseded, it has left traces, which, to the eyes of all who have studied the subject, are broad and deep, on the general aspect of almost every county in England, but especially in the east and centre, on the laying out of roads, on place and field names, and on the surnames of the rural population.

The substitution of the individual occupation and use of agricultural land for the older system of common cultivation was carried out by enclosures. In its effects on the rural population the enclosing movement is an important, and, in some aspects, regrettable development in the social, if not the economic, history of the country. Its character, causes and conditions have within the last quarter of a century attracted the increasing attention of historical students. Of recent years it has become, for obvious reasons, a favourite battleground of political theorists. For the most part the movement has been exclusively studied in its social and political effects. Stress has been rightly laid on the distress caused by the break-up of the agrarian partnerships and on the disastrous consequences of the divorce of the peasantry from the soil. Use has been freely made of a considerable literature of protest and denunciation. The vigorous, picturesque language of sermons, pamphlets and popular verse has been liberally quoted without much discrimination. But very little attention has been paid to the practical questions involved. There is, in fact, a side of the movement which has been unduly ignored

by both historians and politicians. It is the agricultural side. From this point of view the subject of enclosures is suitable for discussion in this *Journal*. But so universal has been the reconstruction of the agricultural industry on the lines with which we are now familiar, and so completely has the older system disappeared from our midst, that it is necessary to begin with a brief description of the open-field farms which, 250 years ago, still formed half the area which was then in cultivation. The picture must necessarily be a general one. Space allows of nothing else. But wide modifications in the system, due to customary variations or local peculiarities, are so numerous, that in its broad features only is the description universally true. Any examination of the origin of the system would be out of place. To discuss it would be to go back into the mists of antiquity, and enter on a region of acute controversy, legal, historical, political and social.

The land of a Manor in the fourteenth century was divided into three unequal areas. The smallest portion was a compact enclosed block, reserved for the private use of the lord, and held in individual occupation. A far larger part was occupied and cultivated on co-operative principles by the villagers in common, as an association of co-partners, both free and unfree, under a rigid regulated system of management which was binding on all the members of the association. The third part was the common pasture, fringed by the waste in its natural wildness. Over this pasture and waste common rights were exercised by the lord of the manor in virtue of his ownership, by the village partners in virtue of their arable holdings, and by the occupiers of certain cottages to which rights were attached. An inquiry into the farming of the lord's demesne land is outside the scope of the present subject. Originally the land had been thrown into the village farm. Its withdrawal from the area of common cultivation was the first breach in the system; but by the middle of the fourteenth century the enclosure of a compact block in individual occupation for the private use of the lord had become very general. Whether it was left in the village farm, or enclosed for private use, it was mainly cultivated by the labour services of the open-field farmers, who paid rent in the form of labour on the demesne for their holdings in the village partnership. The legal and social position of these tenant labourers largely depended on the nature of the services which they thus rendered to their lord. The highest in the social scale were those who gave

team service; the lowest were the manual workers, and the more certain and determinate their labour, the greater their degree of freedom. Of the demesne land nothing further need be said, except that the frequent recurrence of such farm names as Court Farm, Hall Farm, Manor Farm, or Grange Farm, illustrates at once the antiquity and prevalence of such a division of the land.

Isolated farmhouses and buildings were so rare that they may be said not to have existed except on the demesne. Above the tufts of trees which marked the sites of settlements rose the church, the mill, and, at a little distance, the manor house. Gathered in an irregular street were the homes of the villagers who occupied and cultivated the land of the open-field farm. Nearest to the village, if possible along the banks of a stream, lay the meadows. Beyond stretched the open, hedgeless, unenclosed expanse of arable land. Beyond this again ran the common pastures with their fringe of fern or heather, or gorse-clad, bushgrown waste. No part of this area—meadow, ploughland, pasture or waste—was held in individual occupation; all was used in common under regulations as to management by which the whole village community were strictly bound.

The meadowland was annually cut up into lots, and put up for hay. From St Gregory's Day to Midsummer Day the lots were in this way fenced off for the separate use of individuals. After the hay had been mown and carried, the fences were removed, and the grass became the common pasturage of the live stock of the community until the middle of the following March, when the same process was renewed. Sometimes the meadow lots were attached to the arable holdings, so that the same occupier received the same allotment of grass every year. But the more frequent practice seems to have been to distribute them by an annual ballot among the occupiers of the arable land.

Beyond the meadows lay the arable land of the village, divided into three great fields. Each of the three fields was subdivided into a number of flats or furlongs, separated from each other by unploughed bushgrown balks of varying widths. These flats were in turn cut up into a number of parallel acre, half-acre, or quarter-acre strips, divided from one another by similar, but narrower balks, and coinciding with the arrangement of a ploughed field into ridges and furrows. Year after year, in unvarying succession, the three fields were cropped in a compulsory rotation. One field was under wheat or rye; the

second under barley, oats, beans and peas; the third lay fallow. It is scarcely necessary to add that roots, temporary grasses, and potatoes were unknown to the Middle Ages, and did not come into general use on farms until the latter half of the eighteenth century. Each partner in the village farm held a bundle of strips in each of the three fields. Thus, if his holding was 30 acres, he would every year have ten acres under wheat or rye, ten acres under the other corn crops, and ten acres fallow. No attempt could be made to improve the quality of the soil and bring it up to a general average. Equality could only be secured by distributing the different qualities evenly among the partners. In order to divide the good, medium and poor land fairly, the strips which the partner held in each field were widely scattered so that no two were contiguous. From seed-time to harvest the strips were held in separate occupation for the private use of the individual holder. After harvest, and until the next season's cultivation, the live stock of the community wandered over the fields under the care of the common herdsman, shepherd and swineherd.

There were, therefore, common grazing rights at certain seasons of the year over the whole of the meadow and arable land of the partnership. There was also the common pasture of the manor and village farms which lay beyond the meadows and the arable fields. It was fringed by the border of waste which provided fern or heather for litter and thatching, hurdle-wood, and tree-lopings for winter browsing, furze and turves for fuel, acorns and mast for swine, as well as large timber for fencing, implements or building. For the enjoyment of these lesser common rights to the produce of the waste, small annual payments were often made by the village farmers to the manorial lord. Still more important were the common pastures. When the aftermath of the meadows was gone, and the fallows and stubbles were ploughed, they supplied the only keep for the live stock, which, at the best, barely survived the winter as skin and bone. They were therefore highly prized and jealously guarded by the partners in the village farm as an essential and integral part of their holdings. The modern and popular idea of a common is founded on a misconception. The general public had no share in or claim to its use; on the contrary, they were rigidly excluded. The live stock of strangers were driven off; cottages built upon it were pulled down; commoners who turned out more cattle than they were entitled to were "presented" and fined. Those who enjoyed the

common rights over pasture and waste were known and definite individuals. They were, as has been said, the manorial lord in virtue of his ownership, the partners in the village farm, who in theory were limited in the number of stock which they could turn out, by the size of their arable holdings, and the occupiers of certain cottages to which the rights were attached. To them the pastures were common, and to no one else. The rest of the world were trespassers.

Some of the partners in the village farm were freemen, some were serfs; between the two ends of the scale were men who socially, if not legally, held intermediate positions. Their arable holdings were of different sizes, and were held by a great variety of titles and tenures. A few were freeholders; the great majority were copyholders for lives and, later, of inheritance, leaseholders for lives or for terms of years, tenants from year to year or at will. Equally varied were their rents. Some were held by military service; others by team labour on the lord's demesne; others by manual labour, more or less fixed or uncertain; others paid fixed money rents; others produce rents; others a combination of the two. But the great point was that practically the whole of the inhabitants of the village had some interest in the soil other than that of wages. Few, if any, were landless. Even the serfs had some stake in the community, though in the eye of the law they were propertyless.

The open-field farm was, in many ways, well suited to the times in which it flourished. In the early Middle Ages each agricultural community, with its graduated degrees of dependence and its collective responsibility, was organised, like a trade guild, for mutual help and protection. The organisation supplemented the weakness of the law, which was often powerless to safeguard the rights of individuals. It was also adapted to a disturbed and unsettled period. Communities grouped in villages were safer from attack than if the individuals were isolated in detached farm-houses. Their co-operative principle enabled them to maintain, in spite of the frequent absences of able-bodied men, some degree of continuity of cultivation. Their rigid rules of management may have hindered improvement; but they certainly, as long as the soil remained productive, checked wholesale deterioration. Economically they had not yet become detrimental to the national interest. Towns were few and sparsely inhabited. Except in their immediate neighbourhood, there was little or

no demand for agricultural produce beyond the needs of the producers themselves. If the land fed those who farmed it, it might be said to have done its national duty. No distant markets needed supplies of food. Each village community was self-supporting and self-sufficing. Nothing was expected of the soil except that it should meet the want of the necessities of life in the locality where it was situated. The inhabitants held little intercourse with their neighbours. Except along the main thoroughfares they had few means of communication. Such local roads as existed were mere drift ways impassable in the winter. Little was either sold or bought. Every group of village farmers grew its own bread supply; its land or its live stock provided its wants of food, drink, fuel or clothing. Agriculture, still in its comparative infancy, was unprogressive. No improved methods or increased resources were offered to farmers, which could only be introduced on open-fields with the consent of a timid and ignorant body of partners, any one of whom could refuse to have them adopted on the farm. The system fostered stagnation, and starved enterprise; but so long as population and farming remained stationary, no definite economic loss counterbalanced its many social advantages. Obviously, however, occasions might arise when the economic loss might be so great as to outweigh the social gain. When such occasions arose, the reconciliation of the two divergent claims presented a very difficult and complex problem. It cannot honestly be said that the wisdom of our legislators found any satisfactory solution. The variety of interests involved, and of rights enjoyed, some capable of legal proof, others originating in encroachments, others existing only by sufferance, required, if they were to be fairly adjusted, most careful discrimination. They sometimes received scant attention, and, under the pressure of economic necessity, the social advantages were unduly sacrificed.

Even in the infancy of farming the agricultural defects inherent in the common cultivation of land by the open-field system are many and obvious. As farming skill advanced, the objections to it became more and more serious. At first, and so long as the virgin soil retained its natural fertility, these defects were mitigated. But their existence was very early recognised by practical men. The waste of arable land was considerable, owing to the innumerable balks and footpaths. Still more serious was the waste of time and labour. The buildings were sometimes as much as two miles from the

holdings. A holder spent hours in visiting his scattered strips, and the toil of tillage operations was enormously increased by the distances between the different parts of his arable land. The distinction between grass and arable was permanent, though both might profit by conversion. All the occupiers were bound by rigid customary rules, compelled to treat all kinds of soil alike, unable to differentiate in their cultivation, bound to the unvarying triennial succession, obliged to keep exact time with one another in sowing and reaping their crops. Each man was at the mercy of his neighbours. The idleness of one might destroy the industry of twenty. If one partner cleaned his strip, his labours might be wasted by the foul condition of the next. Drainage was practically impossible. If one man water-furrowed his land, or scoured his courses, his outfalls might be choked by the apathy or slovenliness of his neighbour. The supply of manure was inadequate. It need scarcely be said that there were no artificials. Natural fertilisers only existed. The value of town refuse, and other substances, were known to the Middle Ages. So also were the uses of marl and lime and chalk. But such fertilisers, if procurable, were often too costly for small open-field farmers. The dung of their live stock was generally their only resource, and it was wasted over the wide expanse of pasture which the cattle traversed in pursuit of food. Unable to supply adequate winter keep, and possessing no separate closes, open-field farmers reared calves and lambs under every disadvantage. Ill-fed all the year round, and half starved in the winter, the live stock dwindled in size. The crowding of the sheep and cattle on the over-stocked and practically unstinted pasture, or in the common-fold on the stubbles, favoured the generation of all kinds of disease. Stock-breeding on improved lines was an impossibility.

The remedy for many of these defects was individual occupation. A freeholder whose land lay in an open-field farm was only half an owner; a leaseholder found the value of his lease similarly reduced. Only on enclosed land, separately occupied, could men secure the full fruit of their enterprise. To some extent the effective and practical working of the system was increased without substantial change in its framework. It very early became a practice to take in closes for various purposes, especially for stocking; or to make temporary or permanent enclosures from the common, which were often under the plough, and formed the "ancient inclosures" of eighteenth century awards; or even to enclose portions of the

common arable land, a practice known as "several in open." These were useful adaptations of the ordinary common-field system. But they scarcely touched the fringe of the most serious difficulty.

The worst feature in the existing system was the inevitable and progressive decline in the productivity of the soil. Land can be continuously cropped for corn if it is kept clean, well-drained and adequately manured. But the arable land of open fields was often foul. The balks harboured twitch; the fallows left their triennial heritage of docks and thistles. The heavy seeding required for crops points to the necessity of preventing the corn from being smothered by weeds. Drainage, with the appliances which mediæval farmers commanded, was always a puzzle, and on the open fields the task was made harder by the difficulty of obtaining agreement among the contiguous occupiers of the intermixed strips. The supply of manure was always inadequate, and what there was did not always go on the land. It is known from writers of the seventeenth and eighteenth centuries that straw and dung were often used for fuel. Triennial fallows were no sufficient substitutes for clean farming, drainage and fertilisers. Much was taken from the soil and little replaced. Strong evidence exists to show that in the fourteenth and fifteenth centuries the arable land, continuously cropped for corn for several hundred years, was losing its fertility. The yield was falling. Land which had produced a livelihood for a man and his family ceased to supply his necessary food. Portions were being abandoned as tillage. There was difficulty in finding tenants before, as well as after, the Black Death. Fines were paid for the privilege of refusing an inheritance in a holding. Tenants were often obtainable only under compulsion. The obvious remedy was to give the arable land a prolonged rest under grass, and to bring the pastures under the plough in substitution. How to effect this necessary change was one of the agricultural problems of our ancestors. So far as the demesne land of the manorial lord was concerned, it could be withdrawn from the open-field farm, and separately cultivated. When Fitzherbert wrote in 1523, that process was practically complete. Some relief was obtained by bringing under the plough new land reclaimed from the forests. In some cases portions of the common pasture were ploughed. In others the partners in the open-field farms were encouraged to agree to exchange and consolidate their holdings, or to take in separate closes out of the arable fields. Thus

pasture made its way into the area hitherto devoted to the plough. None of these remedies, though each entailed enclosure, broke up the framework of the agrarian partnerships. They were rather devices to adapt the old system to changing needs, and were extensively practised in the fourteenth and fifteenth centuries.

Enclosures of these types aroused no storm of criticism. But they did not meet the real difficulty. That difficulty was, as has been said, the falling productivity of the arable land. With this decline the majority of the partners in open fields were, individually and collectively, too poor to grapple. The more substantial men might have met it by agreeing to such a rearrangement of the arable and pasture land as would enable them to lay down the ploughland to grass, and bring the grass under the plough. But their poorer neighbours could not have borne the cost of the readjustment. The decline, therefore, continued, and was accentuated by the effects of social and political changes. The feudal system was breaking up, and labour services were being exchanged for money rents. So feeble was the demand for land that the occupiers were able to drive hard bargains. Substantial men profited by the change; but it was otherwise with those who were less well off. The poorest tenant might pay his rent by work on the lord's lands; but if he had to pay in money, he might have to sacrifice stock, and so set his foot on the slippery slope which leads to destitution.

The long French Wars of the fourteenth and fifteenth centuries, followed by the Wars of the Roses, were not a period when agriculture was likely to thrive. There is direct evidence that farming was actually deteriorating in its methods. Fitzherbert notices that several useful farming practices had fallen into disuse. One is that of marling or liming, the value of which was well known to mediæval farmers at a very early period. His comparative silence on the subject of drainage indirectly points towards the same deterioration. Neither he nor Tusser mention the shallow drains, filled with stones and turfed over, which were familiar to the farmers of the fourteenth century. To the impoverished occupiers the cost of draining or manuring had become prohibitive, and perhaps, in these and other details of management, the relaxation of the minute supervision of manorial officials was telling its tale. Even without this deterioration in farming practices, the loss of fertility was becoming sufficiently serious. If soil exhaustion

continued unchecked, it threatened to become fatal to many of the open-field farms. The weaker men would go to the wall. The men of substance would meet the decline by exchanging their intermixed strips, and consolidating their holdings. This change was in progress. But, with the agricultural resources then available, the most efficient remedy was the conversion, on a large scale, of arable into pasture, and of pasture into arable. It was only with the greatest difficulty that this change could be effected without destroying the framework of the old agrarian partnerships.

At the end of the fifteenth century the enclosing movement, which had been in progress for many years in a piecemeal form, began to reach its height on a more comprehensive scale. It assumed a more drastic form, which was subversive of the village farm and led to depopulation, because it enclosed the open-fields and converted them to pasture. Its effect on the rural population seized on the popular imagination. A considerable literature of protest and denunciation sprang into existence. Commissions were appointed to inquire into and report on the movement; numerous Acts of Parliament were passed to prevent or regulate its progress. The period 1485-1560 is the first of the two great periods of enclosure which form the special subjects of inquiry. The second is roughly covered by the reign of George III, 1760-1820. Both in the sixteenth and in the eighteenth century writers neglected the agricultural side of the movement. Public attention was fastened on its social effects. Popular passion was excited by the preachers, pamphleteers and ballad writers, who denounced, in the racy language of Tudor times, the "greedy gulls," "idle cormorants" and "caterpillars of the commonwealth" who eat up the patrimony of the poor. The same appeals were repeated in the eighteenth century—and since. To a certain extent they were well-founded. Both periods were epochs of great industrial changes, and in both the rural population suffered. If criticism were concentrated on the omission to take every possible step, which was compatible with the national interest, to retain the peasant's hold on the land, the precise form that enclosures generally took could not be justified. On the other hand, changes were necessary. The smaller open-field farmers were sinking into destitution through the decline in the fertility of the soil, combined, as it was at the later period, with the loss of the domestic industries. Admitting that commercial motives came into play to accelerate

enclosures, the real strength of the movement, both in the sixteenth and eighteenth centuries, lay in the national necessity of restoring, maintaining or increasing the productivity of the soil.

With this aspect of the enclosures of 1485-1560 and 1760-1820, a second article will deal in the January issue of this *Journal*.

MILK RECORDING IN ENGLAND AND WALES.

THE practice among dairy farmers of keeping the records of the milk yields of their cows is one to which increasing attention is being given every day. It is impossible to over-estimate the value of this practice. It enables a farmer to weed out cows which are giving little or no return, to carry out feeding on more economical lines, and to detect an ailing cow more quickly than otherwise would be the case. Such records also supply him with data which are of great value in the breeding or selection of dairy cattle, and enhance the selling value of his cows and their progeny. Without the aid of reliable milk records success in breeding or buying heavy milking cows is most uncertain; when a farmer chooses a sire for use in a dairy herd it is equally important that he should have access to authenticated records of the sire's dam and of as many of the sire's female ancestry as possible.

Milk recording in England and Wales, as organised and supervised by the Ministry, is carried on through the medium of local societies of farmers. Cows of any breed, type or cross can be recorded under the Ministry's Scheme, and although the Scheme is not confined to pedigree animals, practically all prominent Breed Societies interested in pedigree cattle urge their members to record the milk yields of their cows under it. Owners of both large and small herds can belong to the same Milk Recording Society, and they enjoy equal privileges. Members subscribe towards the expense of the Society according to the number of cows in their herds, the annual average subscription being about 5s. per cow; the expense, time and labour involved in recording milk yields is small compared with the advantages accruing.

Milk recording—which is part of the Ministry's general Scheme for the Improvement of Live Stock—although still in its infancy, is making good progress. One of the main objects of the Milk Recording Scheme is to ensure that milk records are kept accurately and stated correctly, since the commercial value of records of this kind must depend entirely on the confidence with which traders regard them.

Under this Scheme the Ministry issues official certificates of milk records. These certificates are not merely a statement of the milk yielded, but are a summarised history of the cow for a year. They give, in addition to her milk yield; her age, number

of times she has calved, date of last calving and when due again to calve, the number of days during the year that her milk yield was recorded, the number on which she suckled a calf or calves, and the number during which she was dry. These official certificates, which are issued under conditions which ensure, as far as possible, that the yields and other particulars stated can be relied on as being correct, are of undoubted commercial value, particularly to the vendor and purchaser of certificated cows and their progeny. Cows of good type and constitution, which have also certificated records, invariably fetch higher prices than those without such records.

Farmers, however, do not even yet seem to realise the financial benefits—apart from increasing the production of milk—which result from their joining a Milk Recording Society under the Ministry's Scheme. The advantages of membership are, however, fully borne out by the result of recent sales of non-pedigree cows with certificates of milk records. At one sale 62 non-pedigree cows sold at an average of 104 guineas apiece, and 3 realised over 200 guineas each; at another, 34 cows sold at an average of 88 guineas, 6 fetching over 100 guineas each. At a third sale the average price paid for each cow was 91 guineas, while 9 cows sold at 100 guineas each. At the second sale referred to 67 heifers with certified milk records realised an average of 59 guineas, the highest prices being 210, 170, 150, 130, 123 and 110 guineas. The whole herd realised a total of 6,476 guineas, and as it was valued by a local valuer less than a month before the sale at £3,812, the appreciation of nearly £3,000 (*i.e.*, approximately £32 an animal, including heifers) may fairly be credited to the commercial value of milk record certificates issued by the Ministry under its Scheme.

The Milk Recording Scheme was inaugurated in 1914, but, owing undoubtedly to war conditions, made little progress in its initial stages. During 1916-17, however, 12,950 cows were recorded under the Scheme. The following year the number increased to nearly 20,000; last year to about 38,000; and this year to over 50,000. Even this latter figure is very small in comparison with the total number of dairy cows in England and Wales, and there seems to be no reason why the number of recorded cows should not be doubled or trebled during the next few years, as the advantages of milk recording become better known and appreciated. There are at present 51 Milk Recording Societies operating under the Ministry's Scheme, and fresh societies are being formed and the existing ones expanded gradu-

ally. Societies whose members keep their records in a prescribed manner and follow certain regulations which have been laid down by the Ministry, receive a grant from the Ministry. This grant was, for the past milk-recording year, fixed at £3 10s. per herd for societies which had been operating for not more than two years, and £3 per herd for older societies (subject in each case to the total grant not exceeding one-half of the total expenses of the society for the year). In order to encourage new members to join societies, however, the higher grant of £3 10s. per herd will now be given for two years in respect of each *new member* who joins a milk-recording society for the first time—whether the society be newly-formed or one already established—instead of it being limited to newly-formed societies.

The milk recording year commences on the 1st October of every year. While it is desirable that new members and societies should commence recording on that date, arrangements can usually be made for a start at any time during the year.

The Ministry issues every year, as part of its Milk Recording Scheme, a Register of Dairy Cows. This Register is not confined to pedigree animals. A cow of any breed, type or cross can be entered in this Register, but only if she has been awarded the Ministry's certificate or certificates declaring that she has yielded not less than 8,000 lb. of milk during a milk recording year, or not less than 6,500 lb. of milk on an average of two or more consecutive milk recording years. Entry in the Register is optional, and, at present, free of cost to the cow owner. The main objects of this Register are:—

- (1) To assist and encourage in England and Wales the breeding and improvement of dairy cattle of any breed, type or cross by publishing annually particulars of cows which have been proved by certificated milk records to possess high-class dairy qualifications.
- (2) To provide authentic records of high-class dairy cattle with a view to bringing sellers and buyers together.
- (3) To encourage the keeping of particulars of cows and heifers (including their certified milk record) which in course of time would make it possible to establish a "Register of Cows with Milk Recorded Pedigrees," into which an animal of any breed, type or cross would be admitted, provided that a satisfactory number of its female ancestors possessed satisfactory milk record certificates.

- (4) To record particulars of the breeding of cows entered in the Register with a view to encouraging the use of pedigree bulls for grading up non-pedigree herds, so that they may become eligible for recognised herd books in due course.

The first three volumes of this Register for the years ended 1st October, 1917, 1918 and 1919, have already been issued. Volume 3 for the year 1919 contains particulars of 2,320 cows and heifers. Copies can be purchased either direct or through any bookseller from H.M. Stationery Office, Imperial House, Kingsway, London, W.C.2, price 5s. net.

The Ministry has also recently issued model rules for the earmarking and registration of calves bred, and bulls used, by members of Milk Recording Societies. This part of the Scheme is entirely optional on the part of both the societies and their members, but many are adopting it, as they recognise the advantage of having calves and bulls officially marked. In addition to the identification afforded by earmarking, records are kept by the societies of each marked calf, showing the date of its birth, its sire and dam, and also the milk yield of the latter if a certificate has been issued in respect of it. Full particulars are also recorded of the sires of the calves, provided that the former are officially earmarked.

The advantages of joining a Milk Recording Society may be summarised as follows:—

- (1) A book and sheets for recording purposes, official certificates of the milk yield of cows, and the entry of recorded cows in the Ministry's Register of Dairy Cows, are, at present, all free of cost to members of societies.
- (2) Cows awarded official milk record certificates, and their progeny, usually fetch more money, when sold, than those without such certificates.
- (3) Every member receives periodical visits from an officer appointed by his society—known as a "Recorder"—whose duties are to assist members by instructing them or their employees how to keep the milk records, which the Recorder himself checks. The Recorder also earmarks every cow in the herd, by means of tattooing, with a registered number which is a means of identification of the cow for her life.
- (4) When a society adopts the Ministry's system of calf-marking a member can also, if he wishes, have his calves earmarked and registered.

- (5) Bulk samples of the milk of the herd, if the owner desires, are taken and analysed for butter fat.
- (6) The milk of individual cows, provided that their owner pays the cost, can also be sampled and analysed.
- (7) Free advice on the feeding and management of a dairy herd can be obtained if desired.

The Ministry has appointed Live Stock Officers, to whom particular districts have been allocated, for the promotion and supervision of schemes for the improvement of live stock. It is one of the duties of these officers to assist members of Milk Recording Societies by giving advice in connection with the breeding and rearing, including methods of feeding, &c., of their stock.

The Ministry will be glad to furnish the name and address of the Live Stock Officer of any particular district on application, and also to supply more detailed particulars of the Milk Recording Scheme to any farmer or association of farmers.

EDUCATION AND RESEARCH IN POULTRY KEEPING.

THE following is a summary of the papers read at the Fourth Annual Poultry Conference, held at the Harper Adams Agricultural College from the 10th to the 12th August last. The subjects on the first day were Breeds and Laying Trials, on the second Education and Research, and on the third the Commercial Aspect of the Poultry Industry.

The proceedings on the second day were opened by Mr. P. A. Francis, Technical Head of the Small Live Stock Branch of the Ministry, who read a paper on "Education in Poultry Keeping." A report of this paper was published in the issue of this *Journal* for last month, p. 753.

The Training of Ex-Service Men.—A paper on this subject was read by Mr. F. W. Rhodes, D.S.O., Lecturer in Poultry Husbandry at the Harper Adams Agricultural College. He said that the selection of ex-service men for instruction was no easy matter. In most cases the men had been recommended to take up poultry keeping as a livelihood, and possessed no previous experience. Men late on in years had to begin an entirely new life by learning a business absolutely strange to them, without capital and severely handicapped in health and body. This called for a tremendous amount of pluck and determination, which had not been found wanting. The men were hard-working, willing and keen. Mr. Rhodes suggested that a course of instruction might be arranged as follows:—

(1) There must be thorough practical instruction and continued practice in all the everyday work of the poultry man. Whenever possible, responsibility should be placed on the shoulders of the individual, as this encourages the person to take an interest in the birds and unconsciously develops one of the most important faculties to success, namely, the power of observation. It is the small things that the experienced eye notices which matter in poultry keeping.

(2) Instruction in hatching and rearing should be as extensive as possible. For the ex-service man the necessity is for instruction and practice in natural hatching and rearing, as he would be unable to bear the expense of incubators and brooders.

(3) The selection of breeding stock and culling by means of external characters form an important part of the training. Whenever possible demonstrations should be given in preference to lectures pure and simple.

(4) Training in rough carpentry on economical lines is

essential. Chicken coops, grit hoppers, food troughs, and other articles of equipment can be made from packing cases, while laying houses may also be built by the poultry keeper himself.

(5) The theory underlying practical work should be dealt with, since it is always easier to do a job properly when the reason of the method is understood.

(6) A knowledge of the early symptoms of common diseases is essential, and, what is even more important, a knowledge of the best methods of prevention of disease and infection. The treatment of diseases is not so important, as the average poultry keeper has not the time to apply the knowledge he may acquire. Unless the bird is a valuable one, it is better to kill it at once.

(7) Apart from poultry keeping, the ex-service man should know something of fruit and vegetable growing. Horticulture and poultry keeping can undoubtedly be worked successfully side by side. Pigs and bees are also subjects that should be understood by the ex-service poultry keeper.

(8) Some knowledge of chemistry, so far as it applies to foodstuffs, and the uses made by the body of the various food constituents, should also be taught.

The benefit the men receive from instruction depends very largely on the way in which the instruction is given. The instructor should know and understand his pupils, and he should be trained in the art of instructing.

Poultry Education in America.—This subject was dealt with by Mr. Edward Brown, F.L.S. In his preliminary remarks he mentioned that the first centre of organised poultry teaching was formed at Gambais, France, about the year 1893; the second at Reading, England, in 1895; and the third at Kingston, Rhode Island, U.S.A., in 1896. The position to-day is that France has made practically no advance; that Great Britain has made considerable progress in elementary poultry keeping, but that higher education has been neglected; while that in the United States and Canada remarkable progress has been made.

Forty-eight of the State Colleges of Agriculture in America have Departments of Poultry Husbandry, with well-trained staffs of teachers and investigators, and plants for teaching and experimental work. In Canada poultry instruction and investigation are undertaken on broad lines in nearly every province. As a result, the United States, with a population little more than double that of the United Kingdom, records an annual production of eggs and poultry equal in value to £250,000,000 as against £53,000,000 in the British Isles, or, *pro rata* to the population, nearly 100 per cent. greater.

Recognising the importance of experimental work and research, about thirty years ago the United States Government made large annual grants which have since been greatly increased. These have been the basis for all developments which have taken place. It was not until the experimental work had been developed that poultry teaching was introduced.

Gradually such investigations have been extended, some over several years, as those on fecundity, by Dr. Raymond Pearl, at Orono, Maine; on breeding, by Professor James Dryden, at Corvallis, Oregon; on heredity, by Dr. Leon Cole, at Madison, Wisconsin; and on diseases, by Dr. Philip Hadley, at Kingston, Rhode Island. Experimental work has formed the basis of all instruction. Without the well thought out investigational work which has been conducted at the Colleges and Experimental Stations, poultry husbandry in America would not hold the high place it occupies to-day.

A well trained and efficient staff of instructors is essential. This need was early recognised in America, and the country now possesses a fine body of instructors and investigators. In the various Colleges and Farm Schools poultry teachers are accorded the same status as their colleagues.

At Cornell, N.Y., the staff of the Department of Poultry Husbandry, apart from office assistants, consists of fifteen members, each of whom undertakes a specific branch of work. Eighty acres of land are allotted for poultry work at the University. The land is divided into two sections: (1) for demonstration work, and (2) for experimental work.

The courses of instruction include both the science and practice of the industry, and also subjects related to animal husbandry. Education is not restricted to students who attend courses. No fees are charged to students who are residents of the respective States, but students are required to support themselves.

Assistance is given to farmers in various ways. Mr. Brown mentioned the following:—

(1) By the issue of Bulletins. These are sent out broadcast, one Experimental Station having a mailing list of 180,000.

(2) By extension work. Members of the staff spend most of their time visiting those engaged in the business of production. It is in this way that such processes as systematic culling are generally introduced.

(3) By encouraging producers to keep in contact with the Colleges, to submit difficulties as they arise, and to avail themselves of the experience of the College specialists.

(4) By annual "farmers' weeks" and poultry conferences. State and county poultry surveys have also been undertaken, and by means of *questionnaires* and personal inquiries much authoritative statistical information has been collected.

Summarising his remarks, Mr. Brown stated that the great Colleges of Agriculture give to the subject of poultry keeping a status in the curriculum equal with other subjects. All Authorities realise that instruction and investigation are closely interrelated, and make liberal grants in both these directions. The staff engaged is adequately remunerated, but a high standard of qualification and experience is demanded. While poultry keeping in its higher branches has been starved in this country, it has been liberally supported in America.

Poultry Research.—Professor Charnock Bradley, M.D., D.Sc., F.R.C.V.S., dealt with the question of poultry research. He said that in the discussion and justification of research two main questions demand answers: (1) Is research worth while? and (2) Is it necessary?

The first turns upon the commercial significance of the industry. An accurate estimate of the world population of poultry is impossible, but an imperfect idea of the importance of the poultry industry in civilised communities can be formed. The country with the largest poultry population is the United States of America. In 1910, on 5,578,528 farms there were 290,350,000 fowls, 3,688,000 turkeys, 2,906,000 ducks, 4,431,000 geese, 1,765,000 guinea fowls, 2,730,000 pigeons, 6,458 pea fowls and 5,361 ostriches. At that time the total value of these birds was £36,000,000, and their value would be much greater now. The figures refer only to poultry kept on farms. In Great Britain such high figures cannot be reached, but information available for poultry on holdings on 4th June, 1908, shows that there were in this country 32,356,000 fowls, 2,963,000 ducks, 712,000 geese, 697,000 turkeys. The number of fowls is now very much greater than it was in 1908.

No figures are available for Continental countries, but their absence is not of vital moment. The importance of poultry as a national asset is recognised in every civilised country, and it cannot be denied that there is a constant and serious loss from disease. Clearly then, if research will diminish this loss, it is abundantly worth while. If research did no more than add the equivalent of but one egg to the annual total of every laying hen in the Kingdom it would add at least £250,000 to the revenue of the nation.

If we turn from statistics to what has actually been done, there is just as convincing an answer respecting the justification of research on the ground of its utility. Research has already thrown much light on obscure diseases, notably in the case of bacillary white diarrhœa. This disease is acknowledged to be caused by a specific micro-organism, and is more than commonly dangerous. A healthy hen may not only transmit it to her chicks, but be the means of infecting healthy premises. One of the triumphs of poultry research has been the discovery that a chick that has recovered from the disease may retain the virus in its system. Later, in the pullet, the ovary may become infected, and the virus handed on in the eggs. It is fortunate that many of such eggs fail to hatch, as if an infected egg hatches, the chick suffers from the disease and transmits it to other chicks.

Research has been principally concerned with the discovery of the cause of disease in order that it may be eliminated. Curative measures, however, have not been neglected, although these, unless applicable in bulk, are not likely to appeal to the poultry owner, except in the case of valuable birds.

Turning to the second question: Is research necessary? an affirmative is not difficult to support. There is no poultry keeper who has not met with cases of disease that could not be labelled with a familiar name. The pathologist freely confesses that he is frequently at a loss to supply a diagnosis. If there are difficult problems still unsolved in mammalian pathology, it is readily understood that there are many more in the much fresher field of avian pathology.

The lecturer mentioned a number of little-known diseases. What is the œdema of the wattles occurring in Australia, the disease recorded by Mazza in Upper Italy, and the semblance of fowl cholera, but apparently caused by a larger organism? What is the cause of fowl plague? Is the so-called avian diphtheria one disease or many? These questions are not purely academic. He would be a rash person who would venture to assert that their answers can be of no practical utility.

Again, there are many diseases that have apparently been reported only once. In these cases it is in the highest degree unlikely that a particular disease has suddenly appeared and then as suddenly disappeared. It is much more probable that it is one of those unidentified diseases met with almost every day.

The relation of parasites to disease also offers a fruitful field for inquiry. Much is known, but this section of parasitology

is not exhausted. Much less is known, however, of the effect of parasitism as contributing to or even initiating disease. Dr. Bradley referred to an interesting investigation which has been concluded by Theobald Smith, into Entero-hepatitis or "black-head" of turkeys.

Though research should be mainly concerned with disease, there are other abnormal conditions that offer a profitable field for investigation. Physiology, particularly the physiology of digestion and nutrition, and the laws of heredity, were mentioned as subjects in which research is needed.

Research in Incubation.—Mr. Tom Newman, in his paper on Research in Incubation, said that the dead-in-shell problem remained much as it was 10 years ago. It is probable that other factors apart from incubation were partly responsible, but the immediate problem was the hatchable egg that did not hatch. No solution could be offered, but if dead-in-shell could be reduced by 10 per cent. an enormous saving would result.

The structure of the egg should be understood. First there was the shell, consisting of calcium carbonate or lime, with just a trace of inorganic materials. The shell is porous, and slow evaporation takes place, while, during the growth of the embryo, carbon-dioxide escapes and oxygen is taken up. Observations have been made on the loss of weight during incubation, and conclusions have been drawn indicating that brown-shelled eggs, which are less porous and of a closer texture than white, are more difficult to hatch. Inside the shell are two membranes; one remains in close contact with the shell, while the inner membrane, following the shrinking of the contents, usually separates from the outer membrane at the large end, forming the air cell. These membranes permit gases to pass through them when moist, but if dry become impermeable.

Graham incubated eggs for one week under hens and finished the hatch in incubators, and also incubated the first week in incubators and finished under hens.

Those started under hens gave satisfactory results, but the other group showed no improvement as compared with eggs incubated artificially during the whole period. Here the problem can be narrowed down to one of temperature. It does not seem that moisture on the intake of oxygen materially affects the development of the embryo. Under a hen the eggs are warmed by being in direct contact with the source of heat. The temperature of an incubator is not evenly distributed, and it may be that during the first few days a number of germs are weakened by insufficient ventilation. The variation, between the centre and

sides of the egg tray, is in some machines as much as 4° to 6° Fahrenheit. Covalt found that the inside temperature of eggs under a hen at three, six, and twenty-four hours was 100° F., and the end of a week 101° F. When a thermometer was hanging on a hook in the incubator the inside temperature of the egg was only 97° , or 8° less than under the hen.

It would appear from this that the best temperature would be 102° F. during the first week with the thermometer lying on the egg, and from then 103° F. until the eggs begin to hatch.

With regard to turning eggs, frequent turnings seem to give the best results.

Correct ventilation is of great importance. In an incubator the carbon-dioxide must be removed or kept below a certain maximum. The carbon-dioxide thrown off varies with the vigour of the embryos. The amount present is important, as if excessive it interferes with the proper intake of oxygen; on the other hand, if the incubators are over-ventilated the membranes of the egg dry down too rapidly, the carbon-dioxide evolved by the embryo does not escape, and the egg is smothered. This explains the greater difficulty in hatching brown eggs in incubators. Under a hen there is a very much greater quantity of this gas than in an incubator, but the gas is largely given off by the hen herself. The ideal seems to be to keep the air in the incubator as pure as possible without allowing it to become too dry. It has been suggested that slacked lime might be kept in the moisture tray instead of water. In this case the lime should be kept fairly wet, as it would have a greater evaporation surface than water. If we can obtain a pure atmosphere without excessive ventilation the big loss occurring from the eighteenth to the twentieth day might be avoided. Deaths during this period are probably due to the fact that insufficient carbon-dioxide is evolved, owing to the drying down of the membranes in the efforts to obtain extra ventilation.

Experiments have shown that better results are obtained where no cooling is practised. Storage of eggs for incubation is also a matter of importance.

The Universities and the Poultry Industry.—A paper on the Universities and the Poultry Industry was contributed by Mr. F. W. Parton, Lecturer in Poultry Husbandry at the Leeds University. The view of Mr. Parton was that the Universities should be the centres to which all living within their area could apply in respect to all questions of difficulty. On the scientific staffs there should be men who could undertake investigational work in all poultry problems, as required. E

DISTRIBUTION OF SITTINGS OF EGGS AND DAY-OLD CHICKS.

NOTES have appeared at various times in this *Journal* explaining the Scheme of the Ministry for the distribution of sittings of eggs and day-old chicks to small holders and cottagers. The Scheme was instituted in 1916 as a war measure, in order to effect a rapid improvement in the strains of poultry stock of this country. It was hoped that the facilities afforded for the purchase of eggs and chicks would encourage many people to use better stock and be a means of relieving the growing shortage of eggs due to the decline in the import trade.

Owing to the scarcity of feeding stuffs during the later years of the War, in consequence of an active Submarine Campaign, a general reduction in the poultry stocks of the country became necessary, and the Scheme was curtailed considerably in 1918 and 1919. The Stations, however, had proved their value, and steps were accordingly taken at the conclusion of the 1919 season for the Scheme to become part of the ordinary work of the County Committees for Agricultural Education, through which it has since been administered locally.

In the season 1920, therefore, the responsibility for undertaking distribution rested upon County Committees to a greater extent than hitherto, but in order to maintain some uniformity in working throughout the country, the Ministry circulated detailed suggestions as to the setting up of Schemes, for the guidance of Committees. Greater liberty was given to the Committees in local arrangements, but it was required that the County Schemes should be submitted to the Ministry for final sanction. No Scheme could be undertaken unless an Instructor in Poultry Keeping were employed, who could be held responsible for the supervision of the distributing stations and assist generally in carrying out the Scheme.

General Outline of the Scheme of Distribution.—Sittings of eggs and day-old chicks are supplied at a fixed price within a

* Particulars of the Scheme and of the Incubating Stations were published in this *Journal*, April, 1916, p. 72, and October, 1916, pp. 685 and 702, and accounts of the working of the Scheme in the issues for December, 1918, p. 1106, and February, 1920, p. 1227.

county. The supply is mainly intended for small holders and cottagers, but distribution may be extended to other persons engaged in rural pursuits.

Breeders of pure bred poultry resident in the county are appointed as Stationholders annually, to distribute from selected stock to applicants within the county areas. In addition to the price paid for eggs or chicks, the Stationholder receives from the Local Authority at the end of the season a small subsidy per dozen eggs and chicks sold. Stationholders are selected by the Local Authorities, following a preliminary inspection of stations, but the sanction of the Ministry to the appointments is required. The County Instructor is responsible for selecting and approving the birds from which distribution is permitted, and for the regular supervision of the work of the Station.

Applications for a supply of eggs or chicks may be forwarded either to the Agricultural Organiser for the county or to a Stationholder direct. Under the conditions of the Scheme no applicant is permitted to receive more than 4 dozen hen eggs, 4 dozen duck eggs, and 2 dozen chicks; in some counties a lower maximum is fixed.

Full details of the Scheme in each county are issued in the form of a leaflet, and particulars are advertised by County Council.

Distribution in 1920.—Distribution of eggs began on 15th January and of chicks on 15th February, and concluded on 15th May in the case of eggs and 31st May in the case of chicks. The largest demand occurred from March onwards, the majority of applicants being dependant on natural methods for hatching and rearing.

Although the total number of Stations had been augmented only by 12 over last season, considerably more eggs and chickens were distributed. The number of sittings of eggs supplied has nearly trebled, while the supply of chicks has increased seven-fold. This improvement is no doubt due in some measure to the removal of the restriction limiting the supply from individual Stations and to the extended facilities provided for the distribution of chicks, but it may also be attributed to a growing appreciation by poultry keepers of the benefits of the Scheme.

The figures in the following tables will enable an estimate to be formed of the work of the Stations during the season 1920 :—

TABLE I.—*Counties and Number of Stations.*

<i>Counties.</i>	<i>No. of Stations.</i>	<i>Counties.</i>	<i>No. of Stations.</i>
ENGLAND.			
Berkshire ...	4	Nottingham ...	3
Buckingham ...	6	Staffordshire ...	5
Chester ...	5	Surrey ...	4
Cumberland and Westmorland...	4	Sussex (East) ...	4
Cornwall ...	5	Suffolk (East) ...	4
Derby ...	2	Shropshire ...	4
Dorset ...	1	Warwick ...	2
Durham ...	4	Wiltshire ...	7
Gloucester ...	4	Worcester ...	2
Hampshire ...	4	Yorkshire ...	26
Hereford ...	3	WALES	
Hertford ...	1	Anglesey ...	5
Kent ...	7	Brecon and Radnor ...	3
Leicester ...	5	Cardigan ...	1
Lincolnshire (Kesteven) . .	6	Carmarthen ...	6
(Lindsey) ...	7	Carnarvon ...	2
Norfolk ...	2	Denbigh and Flint ...	7
Northampton ...	4	Montgomery ...	2
Northumberland ...	2	Monmouth ...	2
		Pembroke ...	3

TABLE II.—*Number of Stations.*

<i>Egg Stations.</i>	<i>Combined Egg and Chick Stations</i>	<i>Chick Stations.</i>	<i>Total.</i>
121	39	8	168

TABLE III.—*Number of Eggs and Chicks Distributed.*

<i>Eggs.</i>		<i>Chicks</i>		<i>Total</i>	
<i>Cottagers and Small holders.</i>	<i>Others</i>	<i>Cottagers and Small holders.</i>	<i>Others</i>	<i>Eggs</i>	<i>Chicks.</i>
118,328	23,283	20,201	733	141,611	20,934

TABLE IV.—*Prices to Applicants and Premiums to Stationholders.*

<i>Price per Doz.</i>		<i>Premium per Doz.</i>	
<i>Eggs.</i>	<i>Chicks.</i>	<i>Eggs</i>	<i>Chicks.</i>
5/6 to 7/6	12/- to 15/-	1/- to 3/-	4/- to 5/-

It will be seen from Table I that only a few Stations have been established in some counties, and that there is considerable scope for the Scheme to be extended.

Some of the most backward areas with regard to the keeping of poultry upon modern commercial lines are least well served with Stations; instances are Northumberland and Dorset. In Somerset the Scheme has not been taken up, while in Wales there is considerable need for development. Carnarvon and Cardigan, two important counties, are poorly served, and the Scheme has not been taken up in Merioneth and Glamorgan.

It will be noticed from Table III that the type of poultry keepers who most require encouragement, namely, small holders and cottagers, are receiving first attention. The demand for day-old chicks is far more difficult to meet than that for sittings

of eggs, but there is evidence that an increased effort is being made in many counties to cope with the demand.

The prices of eggs and chicks and the subsidies to Station-holders were fixed by the County Committees, and varied in different counties. The highest and lowest prices charged are stated in Table IV. The majority of the counties distributed sittings at the minimum figure, and except in a few instances the premium paid was 2s. The general price for chicks was 15s. with a premium of 5s.

In previous years a flat rate over the whole county was fixed by the Ministry, but owing to the varying values in different areas this did not prove altogether satisfactory. A price suitable in the more progressive counties often proved too high in backward areas, where education in the value of keeping better quality poultry has not been widely diffused.

An important result of the Scheme has been the greater attention given to the fact that the services of an Instructor in Poultry Keeping, appointed by the County Council, are available for those who require advice on the management of poultry. The possession of poultry of better quality leads to the desire for knowledge of better methods of management, and many poultry keepers are glad to take advantage of the services of the Instructor in an advisory capacity.

The effect of the Scheme, therefore, has been, not only to increase the numbers and improve the quality of poultry kept throughout the country but also, by the encouragement given to better methods of management, to increase production and give larger financial returns.

It is optional on the part of Local Authorities to put this Scheme into operation, but where adopted the Ministry has contributed two-thirds of the approved expenditure by the Local Authorities on the Scheme.

THE NATIONAL FEDERATION OF WOMEN'S INSTITUTES.

M. FRIDA HARTLEY.

THE Ministry of Agriculture has recently given to the National Federation of Women's Institutes convincing evidence of the support promised at the time of the severance of the latter from the Women's Branch of the Ministry. A "School" or fortnight's free tuition, the first of its kind, has been provided, with board and lodging, to 20 of the County Organisers whose names had been submitted to the Ministry through the Local Federations. The tuition took the form of lectures and practical demonstrations, at two centres, the first being held in the School of Rural Economy, Oxford, and the second at the University of Aberystwyth. The representatives of the County Federations were unanimous in their appreciation of the way in which the subjects chosen built upon their own established experience and demonstrated the wide possibilities for stimulating village life.

The first Women's Institute was formed in 1915, and from that time onwards the movement has met a clearly defined need and has had a clearly defined purpose. Throughout the latter end of the 19th century the rural population in England had been steadily diminishing. The industrial revolution had turned the tide of interest to manufacture and trade, and at the same time, owing to the influx of manufactured goods, was robbing the badly paid labourer of the additional earnings gained by such handicrafts as spinning and weaving, lace making and basket-making. As the century wore on and trades unions began to make their mark, wages had increased somewhat and trade had begun to spread into the country towns. Markets had begun to improve and were more regularly attended, and roads were placed under the control of Highway Boards. The Education Act of 1888 had relieved children to a great extent from the martyrdom endured during the first period of the industrial revolution, and though the effects of that almost incredible period were not to be wiped out in a single generation, the Act was the dawn of a new era of civilisation. At the beginning of the 20th century County Councils had been provided with facilities for secondary or "technical" education, but in the smaller villages at any rate the opportunities for following this out to a practical issue were small. Clubs and reading rooms had been inaugurated, but attendance in many places was

small owing to the monotony of a purely local environment. Hence, in spite of the efforts of pioneers, the stultifying effect of the sensation of detachment was giving way to the craving for a closer connection with the centres of industry, trade and social interest.

The forerunners of the Federation of Women's Institutes were men and women who had wrestled, sometimes single-handed, to open out village life, to find scope for tentative energies and to turn them into practical achievements. They had long realised wherein lay the difficulties of their task. They had seen that the obstacles which so often prevented local attempts at organisation from becoming abortive were not actually lack of imagination and a vague desire for growth on the part of the villagers, but were rather the dire need of a more comprehensive organisation which could link effort to effort, and give them the significance of co-operation. They knew that it must in some way be possible to re-awaken neglected industries inherited by individual women and individual villages from generations back, adapt them to modern requirements and turn them into marketable produce. They knew also that there was latent talent to be developed into adequate means of self-expression for the satisfaction of the owner and for the good pleasure of the community; but only too often the interest aroused perished for lack of a breath of outside encouragement and the stimulus of wide competition. Drawbacks such as poor roads and bad train service, the distance of many villages from their market towns, the shortage of good rooms and halls for exhibitions or entertainments (and the lack of funds to hire these), made the task of local organisers yet more difficult. In some of the villages, therefore, such industries as had begun to flourish were discontinued because the market value was not sufficiently established to admit of the purchase of fresh material.

In many villages yearly fruit and vegetable shows, at which were also exhibited dairy produce and needlework, had become regular and prosperous institutions even before the advent of the Women's Institute Federation, but in other places the anticipated development did not mature. In these cases failure was due to the monotony of a purely local standard of exhibits and to the fact that technical interest was not sufficiently developed to induce perseverance or the spirit of legitimate competition. Then a remedy came.

At the end of the 19th century a small body of women who were anxious to develop country life in Canada had organised

a movement known as the "Women's Institutes." At the start it had aimed at little more than a series of social meetings and a remedy for the loneliness of farm and district life. As time went on, however, the educative and economic side of the scheme reached a stage at which it had received helpful recognition from Provincial Government Departments and occasionally from the Colleges. One of the most remarkable features of the history of the Women's Institutes movement is, that its rapid growth was due not to the result of propaganda but to the actual spontaneity of interest which the movement awakened. It came as a boon to isolated Canadian homes and farmsteads, and the organisers began to realise that the scheme might well become a world-wide one. It soon spread to the United States: the Belgians adapted it to their own needs; and in 1915 Mrs. Watt, Organiser for British Columbia, came over to Wales, and under the auspices of the Agricultural Organisation Society started the Institute which was destined to be a great success in itself and also to be the forerunner of the whole movement in this country.

The constitution of the National Federation of Women's Institutes may be given somewhat as follows:—

Unity of purpose to be ensured by the laying down of general principles and procedure of the movement as a whole.

The National Federation to consist of properly qualified and approved Women's Institutes and County Federations that have made application for membership in accordance with the rules and regulations that may from time to time be approved by the Executive Committee on behalf of the National Federation.

The administration of the work of the National Federation to be vested in:—

A General Meeting constituted of one delegate from each Women's Institute, three delegates from each County Federation, six representatives appointed by the North Wales Union of Women's Institutes, and three Members of the Executive Committee.

The Executive Committee, on which are appointed three members nominated by the Ministry of Agriculture, one member by the Board of Education, two by the Agricultural Organisation Society, one by the National Union of Women Workers and 15 members elected at the General Meeting.

So clearly did the National Federation of Women's Institutes meet a need that no doubts could be entertained of its ultimate success in this country. In many villages the Organisers doubtless had need of much patience and reiterated inspiration to destroy a phlegmatic outlook in minds which had grown rusty by disuse. A new conception of democracy and of the communal life had to be developed in villages where the remains of a feudal

system had reigned for many years, but the new workers were full of the enthusiasm of past success. It was theirs to awake the feeling of sisterhood and partnership amongst women of all classes, by the living bond of communicated knowledge and shared technical interests—a re-awakening in fact of the ideals of the mediæval guilds of craftsmanship. Those who had toiled for years in remote villages now realised how far-reaching was the result of the scheme.

Whilst the movement was still in its infancy the Ministry of Agriculture (in October, 1917) decided that its organisation belonged rather to the Women's Branch of the Ministry than to the Agricultural Organisation Society, and action was taken accordingly. This was done for emergency purposes and for a better centralisation of the work of food production in which the Federation played so important a part. During this connection of two years, the work made rapid growth, the number of Institutes increasing from 180 to 1,100.

In April, 1919, however, when the Women's Branch as a War Department was no longer required, it was decided to leave to the Federation its full self-governing powers, with responsibility for its own propaganda and after-care. It was realised that there would be greater elasticity and scope for originality on the part of County Federations than could be enjoyed under a Government Department in normal times. Nevertheless, the promise was conveyed by Dame Meriel Talbot as Delegate of the Ministry to the Meeting of Representatives of the Women's Institutes in April, 1919, that the Federation was by no manner of means to consider itself as cut off from Government support and Government interest, but that on the contrary every assistance would be given in future in expert advice (a very valuable asset), in the Ministry's Schools for Institute Organisers, and in the recommendation at the time of a grant from the Development Commission. Since that time the Federation has been in the position of a self-governing voluntary institution, with full powers to adapt its methods to the individual needs of the district it serves, but with a strong background of Government interest and support. As such it started on its work anew.

The fortnight's "Schools" for Organisers were a fulfilment of the Ministry's promise, and as the lecturers were University experts whose services had been engaged by the Ministry, a threefold interest has been created owing to the fact that it formed a link between a Government Department, the University and a Voluntary Organisation.

The subjects of the lectures were very varied and were so chosen as to cover practically the whole ground of the Federation's activity, and to add to it a new field of technical and historical interest. The principal Lecturers were Mr. Ashby (Lecturer in the Institute for Research in Agricultural Economics), Mr. C. G. T. Morrison (University Lecturer in Agricultural Chemistry), Mr. C. S. Orwin, M.A. (Director of the Institute for Research in Agricultural Economics), Mr. Ley (Organist of Christ Church Cathedral), Dr. Lund, Mr. Cecil Sharpe, Miss Hadow, and Miss Avice Trench.

Mr. Ashby dealt with Outlines of Rural Development, Mr. Orwin with Local Government and Administration, Miss Hadow with the principles of Organisation from its theoretical and practical sides, and as applied to the efforts of the Federation, and Mr. C. G. T. Morrison with Agricultural Life in its Relation to the Community.

These and other lectures were followed by discussions during which a lively questioning of the Lecturers by members of the audience showed that the latter were well able to bring their practical experience to bear upon the subjects dealt with!

The School at Oxford was followed by another of the same kind at Aberystwyth, and both mark the cordial interest of the Ministry of Agriculture in the growing work of the National Federation. The work of the Federation cannot fail to grow because it comes to meet so great a need. Dame Meriel Talbot struck the keynote of the great spirit of the old guilds of craftsmanship with their aim of a common brotherhood when she pointed out that only through the love and knowledge of the humble things of life a living idealism can be attained. The ideals of the Federation are live ideals because they strive to teach a restless generation that in a desultory search for pleasure or power a man or woman may gain all and yet possess nothing.

THE DISTRIBUTION OF WART DISEASE.

H. V. TAYLOR, M.B.E., A.R.C.Sc., B.Sc.,

Deputy Controller of Horticulture, Ministry of Agriculture and Fisheries.

In the first part of this article, published in last month's issue, an account was given of the possible origin of wart disease, the earliest traces of the disease in this country, and its spread in recent years.

Influence of Disease on the Varieties grown.—In dealing with a disease which is only virulent on certain varieties of potatoes, it can be readily seen that the variety of potato commonly grown at certain periods would influence enormously the rate of spread of the disease. Early varieties at any time apparently exercise but little influence on the spread of the disease, so that only second earlies and maincrop will here be mentioned. The table below gives a list of those potatoes which have been extensively grown in this country since 1850, together with the approximate date of the introduction of the variety to commerce. It must be remembered that the varieties would take some five or six years to establish themselves, so that their influence would not be apparent until some ten years or so after the date given.

<i>Variety</i>						<i>Date of Introduction.</i>
Victoria	...	...	..	...	...	1850
Regents	...	...	..	...	..	1852
Champion	..	...	..	...	...	1867
Magnum Bonum	...	...	...	...	...	1876
Maincrop	...	...	...	...	..	1882
Abundance	...	...	...	...	...	1886
Bruce	...	...	..	...	..	1897
Up-to-Date	...	...	...	...	...	1893
British Queen	...	...	...	.	...	1894
President	.	...	...	...	...	1901
King Edward	...	...	...	..	...	1902
Great Scot	...	...	..	...	...	1911
Arran Chief	...	...	...	..	...	1912

There is no reliable evidence to show that Wart Disease existed in this country in the days of the varieties Victoria, Regents and Magnum Bonum, nor do we know whether Victoria was susceptible to, or immune from, Wart Disease,

* Report of a paper read before the British Association for the Advancement of Science, at Cardiff, on 24th August, 1920.

or whether the two late varieties were susceptible. Champion, Abundance and Maincrop, which were extensively grown after the Regents were given up, were all immune, so that in any case, had the disease existed at this period, little damage would have been caused. About 1877 Mr. Archibald Findlay, of Fife, commenced raising new varieties of potatoes. Working on new lines he endeavoured to breed varieties resistant to "Blight" (*Phytophthora infestans*), and did yeoman service to the potato industry of this country by introducing to it such magnificent cropping new varieties as the Bruce in 1887, Up-to-Date in 1893, and British Queen in 1894. These varieties of potatoes possessed just those qualities that the previous ones had lacked, viz., good shape, colour, quality, and a great cropping capacity, so that after a very few years—from about 1900 onwards—British Queen and Up-to-Date became the varieties popularly grown. Incidentally, these varieties were susceptible to Wart Disease, and it is probable that the disease, which had appeared just prior to this time, finding suitable host plants, firmly established itself during this period.

President and King Edward were introduced to the potato industry soon after 1900, and, being susceptible, these varieties in no way tended to check the disease. Arran Chief, on introduction into Scotland about 1912, was immediately taken up by growers and largely grown. This variety has been for several years one of the most susceptible varieties in existence, and the rapid spread of the disease in recent times must be attributed to the widespread growing of this variety. In so far as reliance can be placed on official statistics, the fact that 66 per cent. of the cases of Wart Disease occurring in England were on Arran Chief gives support to the above statement.

During the 'nineties, our British potato breeders were endeavouring to produce varieties resistant to the destructive "blight" (*Phytophthora infestans*), and to a large measure they succeeded, but at the same time the industry was presented with varieties highly susceptible to Wart Disease. Their newer problem since 1908 has been Wart Disease, and the majority of breeders are now working to produce immune varieties. So far as Secnd Earlies and Maincrop are concerned, they have met with considerable success, and in a few years the potato crop will be comparatively safe from this disease.

Mr. Findlay, of "Up-to-Date" fame, has now introduced the Immune Majestic; Mr. McKelvie, the producer of Arran Chief, has given us Arran Rose, Ally, and Arran Comrade;

Ezra Miles, an old breeder near Leicester (although now living in the North of England), produced seeds which ultimately gave the industry Great Scot, King George, Lochar, Tinwald Perfection, and Rhoderic Dhu.

Influence of Distribution of Seed Potatoes.—It now becomes necessary to consider the way in which these potatoes became distributed throughout the country. In these days potato growers in England and Wales look to Scotland and Ireland for their seed, and rely on the railway companies to make the transport of the goods as convenient and as cheap as possible. Needless to say, such a state of affairs has only been arrived at by stages, each stage possibly having an important bearing on this subject.

As far back as the middle of the nineteenth century potato growers in England and Ireland procured seed potatoes in small quantities from Scotland, but there is a general opinion among merchants that prior to 1895 the transference of seed, which was only on a small scale, was more or less confined to the early varieties.

About 1895, owing to the energies of Mr. Archibald Findlay in breeding potatoes on his farms in Fife and growing a crop of potatoes produced from Scotch seed on his farms in Lincolnshire, and also as a result of the potato trials of Mr. Tom Scarlett of Edinburgh, the demand for seed from Scotland increased.

In 1900 "Blight," sweeping through the Eastern Counties, destroyed a very large number of the commoner varieties then grown, but one of two Scotch varieties raised by Mr. Findlay remained clean. A potato boom was created which increased the importance of these varieties, and the fact that they were Scotch varieties stimulated the Scotch seed potato industry, so that from 1900 onwards the transference of seed potatoes from Scotland for planting in England steadily increased year by year.

Transport and Distribution of Disease.—The simplest and probably the best method of sending seed potatoes is by rail, and this method is probably the least costly for short journeys, but prior to 1914 transit by sea for longer journeys was cheaper. English buyers naturally choose to obtain their seed from districts where the ultimate cost to them would be the least. Thus the southern potato districts of Scotland, Fife, the Lothians and Dumfries were selected for preference. Merchants trading in seed potatoes grown in the more northern districts of Scotland were, consequently, at a disadvantage. They could only market their produce at a lower price than the southern merchant, or choose a less costly method of transit. Transit by shipment, as

previously stated, was cheaper than by rail for long distances *only*. The northern merchants were therefore compelled to adopt this method of transport to secure trade, and, for financial reasons, to choose districts in England fairly remote from Scotland, where shipping ports existed.

Thus the southern merchants of Scotland captured the trade in the North and Midlands of England, with the result that the bulk of the seed sent to, and grown in, Lancashire and the Midland parts of England was derived from the Lowlands of Scotland (Fife, East, West, and Mid Lothian, Glasgow, and Dumfries).

The merchants of the North founded good shipping routes between the East Coast ports of Scotland—Dundee, Montrose and Arbroath—and the Wash ports, London, and in lesser degree Grimsby, and in this way soon captured the trade in South Yorkshire, Lincolnshire, the Eastern Counties, and Kent. Another shipping line was established between Ballintore (in Ross) and Portsmouth and Southampton, so that the bulk of the seed sent to Hampshire and Sussex was obtained from the furthestmost potato county of Scotland (Ross).

Lincolnshire and Lancashire have also from early days produced large quantities of seed potatoes. Those despatched from Lincolnshire were sent to the Southern and South Western Counties, while Lancashire sent much into South Wales and the industrial parts of the Midlands.

From the preceding facts the inference must be drawn that the disease has been distributed with the seed potatoes sent out by rail from the infected parts of South Scotland to the North of England generally, subsidiary infection of the Midlands, North and South Wales having taken place at a more recent date from seed supplied from Lancashire and Cheshire. The concentration of the disease in the North West, the Midlands, and South Wales has been due more to considerations of transport than to influences of soil, or to the fault of the minor with his allotment garden, as has hitherto been believed by many. As very little transference of seed potatoes takes place in a northerly direction, the disease in the South of Scotland has not reached the northern potato areas of Perth, Forfar, Kincardine, or Ross, and all these districts remain clean, or comparatively so, to-day. Thus it is not surprising to learn that in 1916 Lincolnshire, the Eastern and Home Counties, Kent and the South of England were generally free from Wart Disease. Had the distribution of seed potatoes, now outlined, remained fixed, it is probable that the disease would never have

become serious in the South and East; the War, however, had a very direct effect on the distribution, and the system of transport was considerably altered.

Effect of the War on Transport.—With the outbreak of war in 1914, and the German submarine blockade of the North Sea (so far as coastal shipping was concerned) all transference of seed potatoes to England was made by rail. The cost of sending seed by the indirect and long route from Ross, Forfarshire, Kincardine and Perth was great, and in many cases prohibitive. Fife and the Lothians seized the opportunity to develop new trade connections with the Eastern, Home, and Southern counties, and it is a significant fact that the disease has since spread in these areas at an alarming rate.

In 1916, owing to the abnormal conditions prevailing, Lancashire and Cheshire were the only districts where an average crop of potatoes was produced. The crops in other parts of Britain were so small that supplies were used up before Christmas. In the following spring (1917) the Food Production Campaign was started, and there was a general clamour from all parts of England and Wales for potatoes of any sort for planting.

The Irish crop, having been taken and reserved for the Army, was not available for the civil population. Lincolnshire and Scotch supplies were sadly deficient, so there was a general demand for Lancashire potatoes from many parts of England, and large supplies were sent out for planting by small gardeners in the recently established allotment gardens situated around populous areas such as London and Bristol.

By this combination of circumstances the spread of Wart Disease in the years following 1916 was facilitated, and the explanation of the rapid extension of the disease to the potato districts of the Eastern, Southern and South Western parts of England is to be found in the new distribution of seed potatoes brought about by war conditions.

Though conditions of the industry are rapidly improving and many pre-war customs have been re-established, it does not appear that the coastal shipping trade of seed potatoes has been resumed.

In 1919 inquiries in Lincolnshire showed that seed potatoes were being obtained from Forfar, Edinburgh, Perth, Glasgow and Stirling. In Scotland, Wart Disease is widespread in three of the areas mentioned, and if this practice continues experience indicates that Lincolnshire and the other Eastern counties may become heavily infected within a few years.

(To be concluded.)

THE ROOK: ITS RELATION TO THE FARMER, FRUIT GROWER AND FORESTER.

WALTER E. COLLINGE, D.Sc., F.L.S.,
The University of St. Andrews.

DURING the past few years farmers, fruit growers and others engaged in the cultivation of the land have shown an increased interest in the subject of the relation of our various species of wild birds to their calling.

Previously, the attitude of the majority of farmers and fruit growers was one of general condemnation. Upon the most untrustworthy and trivial evidence first one species and then another has been denounced. Many people, however, are no longer willing to accept the opinions of extremists, who either state that all birds are injurious and should therefore be destroyed, or that all birds are beneficial—"farmers' friends"—and should be preserved. All such extreme views obviously contain only a modicum of the truth, and there is a growing tendency, as the result of scientific investigation, to accept the opinion that a few species of wild birds in this country are injurious, but that the majority constitute a natural force of incalculable value to the agriculturist and the nation in general.

In view of this more thoughtful consideration of so important a subject it is extremely desirable that the farmer, fruit grower and forester should be able to obtain authoritative and trustworthy information respecting the various species of wild birds that protect his crops, and of those that destroy or are injurious to them. Further, if that information is to be of any use, it must be presented in such a form that it will be at once capable of interpretation and illustration, and, moreover, open to only one interpretation.

The importance of estimating the food content of birds by accurate methods needs to be emphasised, as if the method is faulty, it follows that incorrect results will be obtained.

Hitherto, in this country, most of the work on this subject has been based upon what is known as the numerical method, i.e., the various items of food found in the stomach and crop have been counted, tabulated and grouped under three headings, as to whether the food eaten constitutes an injury or a benefit to agriculture, or is of a neutral character.

Apart from the fact that long lists of the names of insects, seeds and other foods eaten by birds are very difficult to compare one with another, the results are open to various interpretations. Supposing that we know that a certain bird has eaten 50 injurious and 25 beneficial insects, we learn nothing from these figures as to the ratio one lot of food holds to the other. Again, the apparent ratio of 50 to 25 is inaccurate, for the former may be composed of cockchafer and the latter of ichneumon flies. If, however, we can state the percentage of bulk that these two kinds of insects hold, then we have ascertained a definite piece of valuable information, capable of being used for purposes of comparison.

It must be borne in mind that a bird does not require so many injurious insects, so many beneficial insects and so many seeds per day, but a certain bulk of food, generally speaking three to four times the cubic capacity of its stomach; and if we have to form an estimate of the economic importance of this or that item constituting such bulk, it is essential that we should first know what proportion the particular food item constitutes to the birds' daily requirements. In order to do so we must express ourselves in terms of some method of measurement.

Another very important point to remember is that by the numerical method only part of the food is recorded, whereas it is necessary that every bit of the food taken into the crop and stomach be accounted for.

Let us suppose that the stomach of a blackbird is found to contain a mass of fruit pulp. How can we express this in numbers according to the numerical method? Who can say how many strawberries, blackcurrants, or plums are contained in the mass? To do so is impossible, but the quantity can be expressed in terms of its percentage, or the ratio it bears to the remaining food items, and if we have a sufficient number of stomachs, procured during each month of the year, then we can state very definitely that the amount of fruit found in the stomach of this bird averages, say, 14 per cent. In other words, we would know that this particular species could have eaten more fruit, but that it preferred other food, and also that of the, say, 7 lb. of solid food that each bird of this species requires in a year, 12½ oz. consist of fruit. If the percentage which this figure represents is compared with that of injurious insects and other items, we can quickly form a rough

idea as to whether the sum total of the birds' activities are beneficial or injurious from the fruit grower's point of view.

In short, any system, to be of value, must be open to one interpretation only. It must take into account all the food present in the bird's stomach, crop, &c., and finally it must indicate the ratio which one item of food bears to another. Unless it does this the economic position of a bird cannot be accurately determined. Moreover, by no other method can we obtain the precise and detailed information necessary to enable comparisons to be made of the percentages of the different kinds of food eaten at various seasons of the year and in different districts.

In the light of what has been said, let us turn to a consideration of one of our commonest and most plentiful birds, the rook.

Generally and plentifully distributed throughout the British Isles, there are few of our wild birds better known than this species. Its sociable habits, and the fact that it usually nests in colonies in large trees near to or in the vicinity of human habitation, have all tended to make it familiar to us.

The nest, which is usually built about the middle of March, although both earlier and later dates have been recorded, consists of twigs sometimes solidified with earth or constructed upon the remains of a nest of the previous season, and is generally lined with grasses, roots, hay, straw, hair, wool and leaves. Three to 5 bluish-green eggs, blotched and streaked with olive-brown, are usually laid. Breeding is said to commence when the birds are nearly two years old. Both birds assist in sitting the eggs during the 17 or 18 days of incubation, although the major portion of the work seems to fall to the female. The fledging period has been recorded as occupying 29 to 30 days.

There is good reason to suppose that after the breeding season some of the birds emigrate to the Continent, while towards the end of September and through October and part of November, large numbers arrive on the east coast of Great Britain from Central Europe and Scandinavia, many of them departing in the following February, March, and April.

There would seem to be a general concensus of opinion that during the past ten or fifteen years the rook has largely increased in numbers in the British Isles.

Considerable controversy has taken place for many years past

as to whether the rook is beneficial or injurious to the farmer. So long ago as 1509 an Act of Parliament was passed placing a price upon the head of this bird, owing to the serious injury it caused to cereal crops, and the Act was revived in the reign of Queen Elizabeth.

To the farmer the question is not what a few individual specimens have eaten on a particular day or in a certain district, but what is the average percentage of the different food items eaten during each month of the year, based on the results obtained from a large series of birds, taken from different districts. Once in possession of these figures he can immediately form some estimate of how much damage he may expect from the visitations of these birds in a year, and also form an opinion as to whether this bird is beneficial or detrimental to his interests.

Conducting our investigation on the food of the rook on the lines suggested above, we are able to say, as a result of stomach examinations of a number of birds, that of the total bulk of food consumed in a year, 41 per cent. consists of animal matter and 59 per cent. of vegetable matter (see Fig. 1).

Further inquiry into the nature of the animal matter indicates that there are a number of items of varying quantities; thus we have 23.9 per cent. of injurious insects, 3.5 per cent. of beneficial insects, 4.6 per cent. of neutral insects, 4.4 per cent. of earthworms, 3.2 per cent. of slugs, snails and millipedes, and 1.4 per cent. of field mice, young birds, and the eggs of wild birds. The percentages of the different items are expressed diagrammatically in Fig. 2.

Turning next to an analysis of the injurious insects, we find that click beetles and their larvæ (wireworms) form 6.5 per cent. of the total, ground caterpillars 4 per cent., leather-jackets 5.5 per cent., other larvæ 3.5 per cent., snout beetles (weevils) 3.5 per cent., and miscellaneous injurious insects 0.9 per cent. It is not too much to say that these constitute some of the very worst and most troublesome pests with which the farmer has to contend, and most of them are exceedingly difficult to destroy.

The different items and percentages of the 59 per cent. of vegetable matter are stated in Fig. 3.

Summarising the figures, we find that 52 per cent. of the rook's food constitutes an injury to agriculture, 28.5 per cent. is beneficial, and 19.5 per cent. is of a neutral nature. These percentages are expressed diagrammatically in Fig. 4.

ANIMAL MATTER. 41%
VEGETABLE MATTER. 59%

FIG. 1.

INJURIES. 52%
BENEFITS. 28.5
NEUTRAL. 19.5

FIG. 1

INJURIOUS INSECTS.	23.9	BENEFICIAL. 28.5
SLUGS & SNAILS	3.2	
FIELD MICE, etc.	1.4	
BENEFICIAL INSECTS.	3.5	INJURIOUS. 3.5
NEUTRAL INSECTS.	4.6	
FARTHWORMS	1.1	
		NEUTRAL. 9.0

FIG. 2.

CEREALS.	35.1	INJURIOUS. } 48.5
POTATOES & ROOTS.	13.4	
MISCELLANEOUS VEGETABLE MATTER.	6.1	NEUTRAL. 10.5
WEED SEEDS.	4.4	

FIG. 3.

Before pronouncing a verdict upon the rook, let us consider the significance of these figures from the point of view of the food supplies of the country.

From careful calculations we find that each rook consumes about 16 oz. of food per week, or 52 lb. in a year. Accepting this figure, as being probably reasonably accurate, it follows that 10,000 rooks will consume in a year about 292 tons of food, and in order to obtain this they destroy about—

80 tons of cereals,

32 tons of potatoes and roots,

7½ tons of beneficial insects,

65 tons of injurious insects, slugs, snails, &c.

It seems clear that the birds examined preferred cereals to any other kind of food. Further, we know that, generally speaking, there is no scarcity of the kinds of insects upon which the rooks feed, and that they could have eaten more, but that they chose cereals, possibly as being easier to obtain in the first instance and then as the result of an acquired taste. In all probability there were too many birds feeding upon the same kind of food in a given area, and that which was the most plentiful and most easily procured was taken.

Supposing the rooks had not destroyed this great bulk of injurious insects, would these latter not have done as much harm to cereals, roots, &c., as the rooks did? We think not, as a considerable percentage would have been eaten by starlings, jackdaws and black-headed gulls.

Moreover, there is fairly conclusive evidence that the rook has rapidly increased during the last ten or fifteen years, and records show that where the balance of Nature is disturbed in this manner, a bird almost invariably changes its diet. In other words, rooks are proving injurious because there are too many of them.

Even when reduced in numbers the rook would still continue to feed upon cereals to a certain extent, but the percentage would be considerably lower; in short, the benefits it conferred would exceed the injuries it inflicted, and therefore it would be to the ultimate benefit of the farmer to lose such a percentage of cereals in order to have destroyed the greater percentage of injurious insects, &c., for by no other agency could he so economically and so thoroughly attack these particular pests.

The conclusion we arrive at respecting the economic position of the rook, therefore, is that there are now too many of this species in the country and, as a result, too many birds feed

upon the same kind of food in a given area; in consequence the rook has taken to feeding upon cultivated crops. History shows that this has happened again and again. Repressive measures are taken to reduce the number of birds, and for some years we hear no complaints about them injuring crops, but if permitted again to increase above a certain degree, they again become injurious. Therefore at the present time we strongly advocate repressive measures.

Repressive measures do not involve reckless and wanton destruction; any such unguided policy would, in all probability, lead to very serious and disastrous results. A systematic taking of the eggs or destruction of the nests in districts where the birds are too numerous would probably be sufficient.

If measures of this nature were put into force and carefully carried out, the rook would soon assume its normal place again, and it would prove to be one of the most useful birds to the farmer in helping to control the larvæ of such injurious insects as click beetles and crane flies

In the absence of any census of wild birds it is impossible to state with any degree of accuracy the relative abundance of this species in the British Isles. Such a bird count is urgently needed for this and other species, but only where there is conclusive evidence of the superabundance of the bird should repressive measures be put into force, and then for only a stated period

Twenty-one years ago the late Professor F. E. L. Beal wrote: "It may be said that the damage done . . . has apparently arisen from the excessive number of individuals rather than from the habits of the species. Thoughtful students of nature have observed that every race or species has a certain high-water mark of abundance, beyond which it cannot rise without danger of encroaching upon and injuring other species. This is true of every species, whether at its normal abundance it be beneficial to man or otherwise. The exemplification of this principle is most noticeable in the case of insects, many species of which frequently exceed their ordinary bounds and spread destruction among crops. But the rule is equally applicable to birds; however useful they may be in a general way, it is possible under certain conditions that particular species may become too numerous." This is precisely what has occurred with regard to the rook in this country. It has risen above the "high-water mark of abundance," and in consequence has become injurious.

MANURES IN DECEMBER.

E. J. RUSSELL, D.Sc., F.R.S.,

Rothamsted Experimental Station, Harpenden.

The Purity of Sulphate of Ammonia.—Correspondence has recently appeared in some of the technical papers as to the value of neutral sulphate of ammonia in comparison with the older and somewhat acid material common some years ago, and one correspondent has raised the question as to whether there is any advantage to farmers in the neutral material. In favour of neutrality it is urged that the bags do not rot, as they are liable to do when acid is present; and further, that the neutral material is almost invariably in better condition than is the case with the old samples. Against this, however, it is stated that the trace of sulphate of iron present in the slightly acid sulphate of ammonia becomes converted, on neutralisation, into oxide, which is less soluble than the sulphate, and therefore less valuable as fertiliser.

From the agricultural point of view the neutral sulphate is undoubtedly an advantage. Acidity does not help the farmer in any way; it corrodes the implements, causes the bags to rot, and makes the material unpleasant to handle. We should not be prepared to say whether the condition is improved by neutralisation, or whether some other part of the purifying process may not tend to produce better condition of the samples; it is, however, important that the fertiliser should be in as good condition as possible and free from liability to cake.

So far as is known there is no advantage in the trace of iron present in the commercial sulphate, and it is quite immaterial from the farmers' point of view whether this is present as sulphate or as oxide. Ordinary agricultural soils contain from $2\frac{1}{2}$ or 3 per cent. up to 6 per cent. or more, or, stated in weight, from 25 to 60 tons or more per acre. It is highly improbable that the small additional amount added in sulphate of ammonia would exert any effect.

Periodically we are asked whether the unusual ingredients—iron, manganese, &c.—are of value as fertiliser. It is known that some of them may act beneficially in physiological experi-

ments carried out in sand or water cultures, but there is a very marked difference between these conditions and those obtaining in the soil. There is little, if any, evidence that small quantities are effective, and only occasionally are results obtained indicating that larger amounts are beneficial.

Use of Potash on Grass Land.—The question has been asked whether potash fertilisers are as beneficial as slag on grass land. Potash fertilisers do not produce so striking a change as slag; nevertheless, they are often of value on land laid in for hay, increasing both the quality and the quantity of the herbage. It is not so clear, however, that they are effective on grazing land, although even here improvement has resulted, especially on light or chalky soils. As a rule potash might be expected to give good results on any grass land where salt is known to be beneficial. In such cases the muriate would probably be as effective as the sulphate.

Sylvinite as a Potassic Fertiliser.—A correspondent who uses large amounts of potash states that he is experiencing some difficulty in securing supplies, and asks whether sylvinite is likely to be useful. This material is supplied in two grades, the declared analyses of which are :—

Description of the Salts	Potassium Chloride	Sodium Chloride.	Calcium Sulphate.	Insolubl
-----	-----	-----	-----	-----
	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
Sylvinite 14, (French kainit)	19—25	60—66	2—5	10—12
do. 20—22% K_2O	32—35	50—55	2—5	9—10

There is every reason to believe that this material is of considerable value to mangolds, and on light and chalky soils for wheat and temporary leys. It might not prove so useful as sulphate of potash for potatoes, however, owing to the large amount of chlorides present.

Effect of Magnesium Salts as Fertiliser.—A correspondent has asked whether the magnesium salts present in kainit are likely to be harmful, or whether they might not exert some beneficial effect.

For ordinary farm crops, and particularly mangolds, sulphate of magnesia is not harmful, and indeed it may exert a beneficial effect. This is shown in the Rothamsted experiments on wheat. The crop yields were as follows :—

Effect of Alkaline Salts upon the Wheat Crop (Rothamsted).

Plot	Alkaline Salt added to Ammonium Salts and Superphosphate in Manure	1852-1861	1862-1871	1872-1881	1882-1891	1892-1901
Grain, bushels.						
11	None	28.4	27.9	21.7	22.7	19.5
12	Sulphate of Soda	33.4	34.3	25.1	30.1	26.7
13	Sulphate of Potash	32.9	34.8	26.8	32.5	29.6
14	Sulphate of Magnesia	33.5	34.4	26.4	31.1	25.0
7	Sulphates of Soda, Potash and Magnesia	34.7	35.9	26.9	35.0	31.8
Straw, cwt						
11	None	28.2	24.5	21.3	20.8	18.8
12	Sulphate of Soda	31.2	30.5	25.0	27.3	24.0
13	Sulphate of Potash	34.1	33.4	27.6	31.9	28.6
14	Sulphate of Magnesia	35.0	30.7	26.3	28.6	23.4
7	Sulphates of Soda, Potash and Magnesia	36.1	34.3	28.7	34.1	31.1

It will be observed that Plot 14, supplied with sulphate of magnesia, gave for many years results as good as Plot 13, supplied with sulphate of potash, although subsequently it fell behind considerably. Analysis shows that magnesia enabled the plant to obtain more potash from the soil than it would otherwise have done, and there is further evidence that magnesia enables the plant to make fuller use of the potash it is able to obtain. Similar remarks apply to sulphate of soda, which, also, is not harmful, but indirectly beneficial, increasing the availability of the soil potash.

Care of Manure Heaps.—Now that the season for clearing the yards is at hand we must again emphasise the need for avoiding waste of farmyard manure. It has been shown, both on the heavy land at Rothamsted and on the light land on Lord Elvedon's farm at Woking, that a sheltered manure heap is better than one exposed to the air, even a little shelter being better than nothing. The farmer gains in two ways: the resulting manure is better ton for ton, and there is more of it. The gains due to sheltering were:—

At Rothamsted						Excess of yield from sheltered heap over that from exposed heap
Potatoes	...	...	...	...	...	7 cwt. per acre.
Wheat grain	...	...	...	...	...	5 bush per acre.
do. straw	...	...	...	...	...	4 cwt per acre
At Woking						
Wheat grain	...	...	...	...	...	2 bush per acre
do straw	...	...	...	...	...	2 cwt. per acre

Effect of Sheltering Manure: a Practical Trial.—A correspondent from Ireland sends particulars of a trial conducted to ascertain the effect of providing shelter for farmyard manure

after it has been made into a heap for application in the field. Two heaps were made up as nearly equal as possible; one was sheltered under a shed, and the other left in the open in the ordinary way. When the time came for application to the land approximately equal weights from the two heaps were applied to equal areas of land, viz., about 18 tons per acre. The crop grown was potatoes (Arran Chief), and the results were:—

					tons.	cwt.
Covered manure...	...	...	...	...	9	14½
Not covered	...	..	...	...	7	14¾

It would appear, therefore, that sheltering the heap caused a distinct improvement in value and led to an increase of nearly two tons in the crop. It is probable that the benefits were even greater than appear, as the sheltered heap would be likely to weigh more than the unsheltered in the end, owing to less loss through the washing of rain.

Application of Superphosphate and Potash on Stubbles.—

A farmer has inquired whether there is any objection to sowing superphosphate and potash on the stubble previous to ploughing. He points out that if these fertilisers are applied the manure distributor runs much more easily than on ploughed land, and that the whole process is cleaner and more convenient. So long as the ploughing is not too deep there is no objection to sowing these fertilisers on the stubble, as there is no great risk of their being washed out; if, however, they are ploughed in below the depth of the seedlings they will be out of the way of the young plant roots just at the time when they are most wanted. On the whole the ordinary practice of drilling manures at or about the time of sowing is more effective.

Organic Manures.—Results obtained in careful tests of organic manures at Rothamsted show the following order of merit when Peruvian guano, rape cake and shoddy are compared on the basis of equal amounts of nitrogen per acre. The results are from yields obtained in the year of application.

Peruvian guano	...	...	...	...	..	100
Rape cake	...	...	...	...	.	91
Shoddy	...	...	...	...	...	88

Shoddy showed a residual effect which would improve its position.

Leather as Manure.—Considerable interest has been evinced from time to time in the question as to whether leather waste can be converted into manure. There is a very real shortage

of organic fertilisers, and anything that would help to increase the supplies would be welcomed. Attention may be directed to the experiment carried out at the Woburn Station, where ground leather powder was applied on swedes at the rate of 1 ton per acre to one plot, while another received 1 ton per acre of leather treated with sulphuric acid so as to make the nitrogen soluble; a third plot received a dressing of sulphate of ammonia supplying as much nitrogen as was in the leather. Sulphate of ammonia produced its full effect, but the leather had no action at all.

Comparison of Bone Meal with Slag.—An interesting experiment has been in progress for some years at Cockle Park, to test the comparative values of bone meal and basic slag on hav land. The results are:—

Plot	Treatment per Acre, Feb., 1908 Redressed Dec. 1910 Dec. 1916, and Dec. 1919	Average Annual Cost of Treatment.	Hay Per Acre		Value of Increase at 5/- per ton	Average Annual Gain.
			1919	Average of 12 Years.	Average Increase over Plot 1	
1	(To the west) No treatment	s. d.	—	—	—	—
2	10 cwt High Grade Basic Slag , 39.32% Phosphates (200 lb. Phosphoric Acid)	8 0	13½	22½	15½	38 1
3	14 cwt Medium Grade Basic Slag , 27.39% Phosphates (200 lb. Phosphoric Acid)	9 4	24	21½	14	35 0
4	19½ cwt. Low Grade Basic Slag , 19.82% Phosphates (200 lb. Phosphoric Acid)	10 8	17½	19½	12	30 0
5	8½ cwt Bone Meal , 45.09% Phosphate (200 lb. Phosphoric Acid)	18 8	14	20½	12½	31 11

Bone meal is shown to have given a marked increase in yield over the unmanured plot, but it is no better than medium grade slag and not so good as high grade slag. The financial return from bone meal has been less than from any of the slags and less than half from the best slag plot.

Value of the Solubility of Basic Slag.—Mr. Scott Robertson has recently summarised the results obtained by the use of the various slags and mineral phosphates in Essex. His results throw considerable light on the important question as to whether the farmer is justified in paying extra prices for high soluble slags. The crop returns show that high grade slag is, as a matter of fact, rather better than low grade, especially in

improving the quality of the herbage. The difference is not so great as would be expected from the difference in solubility, and it seems clear that present-day analytical methods do not deal satisfactorily with present-day slags; this subject is under further investigation. Meanwhile, Mr. Robertson's experiments show that ground rock phosphate is distinctly useful on grass land, being little, if any, inferior to some of the basic slags. Farmers who have difficulty in obtaining a supply of slag, therefore, may make trial of some of these mineral phosphates. Mr. Robertson's results are as follows:—

Manures, 200 lb P ₂ O ₅ per Acre	Citic Solubility of the Phosphate	Hay, Cwt per Acre					
		Boulder Clay.		London Clay.			Chalk
		Ty-sea Hill, Average of 4 Years	Martin's Pearne, Average of 3 Years	Letchington Average of 4 Years	Horndon 1 Year	Lambourne End 1 Year (1919)	
High Grade Basic Slag	92	30.9	—	31.7	—	—	41.2
Gafer Rock Phosphate	33	30.5	29.1	29.7	23.0*	25.0†	38.7
No Manure	—	20.3	16.0	21.7	15.0	13.2	31.1
Open Hearth Fluorspar	—	—	—	—	—	—	—
Basic Slag (1)	45	32.8	—	30.8	—	—	40.0
do. do. (2)	20	—	22.7	—	18.8	26.6	—
do. do. (4)	32	—	—	—	—	16.0	—
Low Grade High Citric	—	—	—	—	—	—	—
Sol Basic Slag (1)	93	32.8	—	31.6	—	—	35.2
do. do. (2)	82	32.3	—	33.9	—	—	40.2
do. do. (3)	91	—	30.2	—	22.5	24.5	—
do. do. (4)	80	—	—	—	—	23.7	—
Average Rainfall, 1st May until Harvest (inches)	—	1.66	6.91	4.88	2.28	3.26	2.74
do. 1st April until Harvest (inches)	—	7.02	9.35	7.11	4.64	6.46	5.26

* Egyptian phosphate.

† Cambridge coprolites.

The analyses of the crops gave the following results:—

Type of Vegetation.	Farnham (Boulder Clay Soil).			Horndon (London Clay Soil).		
	Plot 1. Open Hearth Basic Slag (Solubility 20 %).	Plot 2. High Citric Soluble Basic Slag (Solubility 91 %).	Plot 3. No Manure.	Plot 18. Open Hearth Basic Slag (Solubility 20 %).	Plot 17 High Citric Soluble Basic Slag (Solubility 91 %).	Plot 16. No Manure.
	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
Clovers ...	27.1	50.2	16.2	43.8	46.2	9.4
Grasses ..	45.0	33.3	14.4	31.8	47.2	19.1
Weeds ...	16.0	13.5	25.0	13.3	1.4	26.0
Bare Space	11.9	3.0	40.4	11.1	5.2	45.5

Liming and Chalking.—From the large amount of correspondence received at Rothampsted on the subject of liming and chalking, it is evident that farmers take great interest in this subject. There is no need to emphasise the importance of lime; every farmer knows it. There is, however, considerable difficulty in practice in getting the work done, and it is worth considering whether co-operative societies could not usefully help.

Mr. Harald Faber gives an account of the "Marling" Societies of Denmark* which distribute marl or chalk from the quarries for use on the land. The societies arrange for a district to be treated and then lay a light movable railway as far as they can so as to facilitate transport. The undertaking was started as a single private venture with a small Government Grant. The profits are limited by statute and are put into the business as new capital. During the years 1904-16 these societies transported over 3,000,000 cubic yards of marl on their light railways. If some such organisation could be established in this country it might be expected to give very good results.

* "Co-operation in Danish Agriculture," by Harald Faber. London Longmans, Green & Co., 1918.

FEEDING STUFFS IN DECEMBER.

E. T. HALNAN, M.A., Dip. Agric. (Cantab.),

*Ministry of Agriculture and Fisheries,
Formerly Physiologist, Animal Nutrition Institute, Cambridge.*

As notified in the November issue of this JOURNAL, the preparation of these notes will in future be undertaken by the Intelligence Department of the Ministry. Mr. Halnan has for the past eight years worked in close association with Professor Wood at the Animal Nutrition Institute, Cambridge, on questions affecting Animal Nutrition, and in the future preparation of these notes will maintain close contact with Professor Wood, and the results obtained at Cambridge. Criticisms of the notes published, and suggestions for their improvement, will be welcomed.

PRICES of feeding stuffs have eased somewhat during the past month, maize, beans, peas, imported feeding barley, ground nut and common cotton cake all showing a decline in price. A few feeding stuffs have firmed in price, and reports indicate that the decline in the price of commodities foreshadowed in last month's notes is not likely to be followed at all closely by a corresponding decline in the prices of feeding stuffs.

Wet grains, from the price standpoint, are still the cheapest feeding stuff on the market. The advantage to be gained by using wet grains is not as marked as the price would indicate, in view of the bulky nature and waste in feeding. In this connection, several correspondents have inquired whether it is possible to store wet grains. This practice is common in Kent, and can be carried out with advantage wherever the farm is provided with pits or vats for storage. The grains are trodden well down when filling the pit, and in some cases a slight sprinkling of salt is scattered over the surface layer at foot intervals. The pits must be protected from rain. Grains thus stored will keep wholesome for months. It is desirable to have two pits, if possible, so that when feeding from one pit the other pit may be ready for filling with fresh grains. Feeding commences from the top of the pit and proceeds until the pit is completely empty. It is then ready for re-filling.

Among the oil cakes, palm kernel cake and coconut cakes form the cheapest feeding stuffs on the market. These cakes are particularly suitable for feeding to dairy cows.

NAME.	Price per Qr.		Price per Ton.		Manurial Value per Ton.	Food Value per Ton.	Starch Equiv per 100 lb.	Price per Unit, Starch Equiv.			
	s.	lb.	£	s.	£	s.	£	s.	d.		
Barley, English Feeding	55/-	400	23	16	1	6	22	10	71	6/4	3.39
" Foreign	72/-	400	20	3	1	6	18	17	71	5/4	2.86
Oats, English	59/-	386	19	13	1	9	18	4	59.5	6/1	3.26
" Foreign	56/-	320	19	12	1	9	18	3	59.5	6/1	3.26
Maize	73/-	480	17	0	1	5	15	15	81	3/11	2.09
Beans, English spring	95/-	532	20	0	3	1	16	19	66	5/2	2.77
" " winter	90/-	532	18	19	3	1	15	18	66	4/10	2.59
" Chinese	20/-	112	20	0	3	1	16	19	66	5/2	2.77
Peas, English blue	102/-	504	22	13	2	13	20	0	69	5/10	3.12
" " dun	100/-	504	22	4	2	13	19	11	69	5/8	3.03
" " maple	107/-	504	23	15	2	13	21	2	69	6/-	3.21
" Japanese	150/-	504	33	7	2	13	30	14	69	8/11	4.77
Buckwheat	—	—	—	—	—	—	—	—	—	—	—
Rye, English	84/-	480	19	10	1	8	18	2	72	5/1	2.73
Millers' offals—Bran	—	—	14	10	2	10	12	0	15	5/4	2.86
" " Coarse middlings	—	—	15	10	2	10	13	0	64	4/1	2.19
Barley meal	—	—	25	0	1	6	23	14	71	6/8	3.53
Maize " " "	—	—	19	0	1	5	17	15	81	4/4	2.47
Bean " " "	—	—	21	0	3	1	29	19	66	6/4	3.39
Fish " " "	—	—	25	0	7	12	14	8	53	6/7	3.53
Cakes, Linseed	—	—	23	0	3	12	19	8	74	5/3	2.41
" Soya	—	—	24	0	5	4	18	16	69	5/3	2.81
" Cotton seed	—	—	13	10	3	5	10	6	42	4/10	2.59
" Cotton seed decorticated	—	—	20	10	5	6	15	4	71	4/3	2.28
" " decorticated meal	—	—	20	10	5	6	15	4	71	4/3	2.28
Coconut cake	—	—	16	0	3	0	13	0	79	3/3	1.74
Groundnut cake	—	—	13	15	3	9	10	6	57	3/7	1.94
" " decorticated	—	—	18	0	5	5	12	15	73	3/6	1.47
Palm kernel cake	—	—	13	0	2	1	10	19	75	2/11	1.56
" " meal	—	—	13	5	2	1	11	4	75	3/-	1.61
Brewers' grains, dry	—	—	11	12	2	7	9	5	49	3/9	2.01
" " wet	—	—	1	4	0	12	0	12	15	0/10	0.6
Distillers' " dry	—	—	12	12	2	16	9	16	57	3/5	1.83
" " wet	—	—	1	7	0	13	0	14	16	0/10	0.16
Malt culms	—	—	10	7	3	6	1	1	43	3/3	1.74
Potatoes	—	—	4	17	0	8	3	9	18	3/10	2.00
Sweeties	—	—	1	12	0	5	1	7	7	3/10	2.00
Mangold	—	—	1	9	0	6	1	3	6	3/10	2.00

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in the larger markets, usually London, and refer to the price ex mill or store. They are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is off red locally at £15 per ton. Its manurial value is £2 1s. per ton. The food value per ton is therefore £12 19s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 3s. 6d. Dividing this again by 22.4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1.88d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

Experiments carried out with weanling pigs of the Tamworth breed have demonstrated that beet molasses is an unsuitable feed for weanling pigs. Thirty pigs aged 9 and 12 weeks were fed on a ration of two parts ground barley and three parts wheat shorts. The pigs were divided into three lots of ten each; two of these lots received in addition to the above ration a certain quantity of beet molasses. Of the twenty pigs receiving molasses no less than fourteen died before the end of the experiment, whereas not a single death occurred in the lot receiving ground barley and wheat shorts only. The harmful effect of the molasses was also evident in the surviving six pigs. It is, therefore, very evident that in compounding rations for weanling pigs care should be taken to avoid the inclusion in the ration of any feeding stuffs containing molasses as one of its items

QUESTIONS IN PARLIAMENT.

Arable Cultivation.—In reply to Mr. Royce, the Parliamentary Secretary to the Ministry stated that information as to the acreage of arable land in the whole of the United Kingdom in 1920 was not available, but that the acreage of land under arable cultivation in England and Wales on 4th June, 1920, was 12,020,000 acres, 289,000 acres less than a year earlier, and 379,000 acres less than on the 4th June, 1918. He added that the area of land under arable cultivation at 4th June, 1920, was 1,022,000 acres greater than at 4th June, 1914, when the total was 10,998,000 acres. (1st November, 1920.)

Wheat Production.—In reply to Mr. Cape, the Parliamentary Secretary to the Ministry stated that the returns of the production of wheat this year were not available for the whole of the United Kingdom, but that the estimated production in England and Wales was 6,677,000 quarters. The average annual quantity used for seed in the past 10 years was estimated at about 750,000 quarters. (1st November, 1920.)

Foot-and-Mouth Disease.—In reply to Major D. Davies, the Parliamentary Secretary to the Ministry stated that the prolonged inquiry had failed to establish any relation between imported packing material and the numerous invasions of Foot-and-Mouth Disease which had occurred. The importation of hay and straw from all European countries, except Norway, was already prohibited, with certain exceptions, which included hay and straw actually used for packing merchandise. The Departmental Committee on Foot-and-Mouth Disease, in its report dated May, 1912, stated that it recognised that packing straw constituted a source of danger, but that, in view of the serious dislocation of general trade which such action would entail, the Committee was not prepared to advise its prohibition until there was further evidence against it. In the absence of any evidence connecting the outbreak of Foot-and-Mouth Disease with packing materials, the Ministry was not prepared to consider the prohibition of the importation of hay and straw in every form. (27th October, 1920.)

Land Settlement of Ex-Service Men.—In reply to a question by Mr. Winttingham, the Parliamentary Secretary to the Ministry stated that the number of men actually settled and in possession of their holdings under the Land Settlement Acts was 8,314, of whom 7,610 had been settled by County Councils, and 704 on the Ministry's farm settlements. In addition, sufficient land had already been acquired to settle a further 8,866 men as soon as it could be equipped and made available. The total number of applications received was 43,175, of whom 24,474 had been approved. The total number of acres acquired was 257,859. He stated that he could not give complete figures of expenditure on land purchased, but as regards 219,604 acres, of which he had returns, the cost was £9,315,000, or £42 per acre. He had no information of the advances made by County Councils, but 25 advances had been made by the Ministry, totalling £3,640. (21st October, 1920.)

In reply to Capt. Coote, the Parliamentary Secretary to the Ministry stated that it was not correct to say that the moneys voted by Parliament for the purpose of carrying out the provisions of the Land Settlement Act were about to be exhausted, or that it had cost £20,000,000 to put about 9,000 men on the land. The land already acquired, namely, 259,489 acres, would cost, when fully equipped, about £15,000,000 for purchase, buildings, roads, water supply,

&c., and some 17,200 men would be settled on this area. The present position of land settlement in England and Wales had recently been thoroughly investigated by a Cabinet Committee, and a letter was about to be addressed by the Ministry to each County Council, embodying the decisions which had been reached, and, *inter alia*, stating that additional funds would be provided by the Treasury for land settlement purposes. (1st November, 1920.)

In reply to Capt. Terrell, the Parliamentary Secretary to the Ministry stated that the total number of ex-service men who had applied to the Ministry and to County Councils and Councils of County Boroughs was 44,229. Up to the present 25,038 had been approved and about 7,700 were awaiting interview as to their qualifications. The area acquired since the 1st January, 1919, was 280,553 acres, and proposals for the acquisition of a further 30,000 were at present under consideration by the Ministry. The number of men actually settled was 10,487, of whom 9,042 were ex-service men, and it was estimated that the land acquired and not yet let would provide holdings for a further 8,000 men, as soon as the additional cottages and buildings could be erected. (15th November, 1920.)

Farm Colonies.—In reply to Mr. G. Roberts, the Parliamentary Secretary to the Ministry stated that the number of farm settlements in England and Wales was 14, and the settlers numbered 706. Of these 531 were ex-service men, and 14 were ex-service women. Seven settlements contained a central farm. The purpose of the latter was not, however, to train men, as all settlers were required, before admission, to have had sufficient experience or training to manage a small holding, or to undertake other farm work. (25th October, 1920.)

Allotments.—In reply to Captain Terrell, the Parliamentary Secretary to the Ministry stated that he was not in a position to say how many allotments had been created since the beginning of the year, and how many had reverted to other uses. A return would be obtained after the end of the year from each allotment authority in England and Wales, showing the acreage acquired for allotments and the number of allotment holders provided for under the Small Holdings and Allotments Act, 1908, and the Land Settlement (Facilities) Act, 1919, and it was proposed to embody in the Ministry's Annual Report to Parliament under Section 59 of the Small Holdings and Allotments Act, 1908, a summary of the information thus obtained. (1st November, 1920.)

Exported Horses. Standard of Fitness.—In reply to Major Steele, the Parliamentary Secretary to the Ministry stated that his attention had been called to articles appearing in the Press on the subject of the sale of worn-out horses to the Continent, and that the statements appeared generally to be made under a misapprehension as to the facts. The Diseases of Animals Act, 1910, as amended by the Exportation of Horses Act, 1914, prohibits the shipment of worn-out horses without a written guarantee from a veterinary inspector of the Ministry, to the effect that the horses are capable of being conveyed and worked without suffering.^o The Ministry insists on a strict interpretation of the standard of fitness. The average price of the exported horses, was, he understood, £28, and the cost of shipment varied between £4 and £6. He had no reason to believe that any horses were being shipped which failed to reach the requisite standard. (1st November, 1920.)

^o See the issue of this *Journal* for last month, p. 709.

AGRICULTURAL RETURNS, 1920:

PRODUCE OF CROPS IN ENGLAND AND WALES.

The following Memorandum on the Agricultural Returns of England and Wales for 1920 was issued by the Ministry on the 1st November :—

The corn crops were adversely affected by the cold, sunless weather of the past summer, and are not threshing out so well as farmers expected. This applies more particularly to wheat and oats in the west of England and in Wales. Harvest was late and is not yet over, and in some of the later districts much less threshing than usual has been done. Crops ripened slowly, and in the north a larger acreage than usual has been cut green. The harvest has been very protracted, but on the whole the corn in many parts has been secured under moderately favourable conditions. In the later districts in the north some grain has sprouted, owing to the absence of drying winds and the prevalence of heavy mists and dews.

The total production of *Wheat* in England and Wales is estimated at 6,677,000 quarters, which is 1,300,000 quarters less than last year. The yield per acre, 28·5 bushels, is slightly less than last year, and the smallest since 1904. On the average the yield per acre over most of the eastern counties is about 1½ bushels above the ten-year mean, but in Lincolnshire and the East Riding yields are not so large as usual. Crops were very bad in the west-midland and south-western counties, where the yields average about 7 bushels per acre less than the ten-year mean. *Barley* is the most satisfactory of the three chief corn crops, the yield, 31 bushels per acre, being very slightly below average. As with wheat, results were most satisfactory in the eastern counties and poorest in the west midlands and south-west, though in Cornwall barley gave over-average results. The total production is 6,336,000 quarters, an increase of 860,000 quarters as compared with last year, and 670,000 quarters above the average of the previous ten years. *Oats* yielded 38 bushels per acre, or nearly 2½ bushels more than in 1919. Over-average yields were the rule in the eastern half of the country, while in the western half the results were in the opposite direction, crops being worst in Wales and the south-west. The total production has amounted to 10,760,000 quarters, which is about 160,000 quarters above the ten-years' average, but 660,000 quarters less than last year. *Mixed corn* averaged 33·1 bushels per acre, and produced 605,000 quarters, or 17,000 quarters less than in 1919. *Beans* were a satisfactory crop, the yield per acre, 31·1 bushels, being about 3¼ bushels above the decennial mean and 6 bushels more than last year. The total crop is 956,000 quarters, an excess of 100,000 quarters over last year. *Peas* also gave an over-average yield, 27·4 bushels, or 2½ bushels more than usual. The total production, 444,000 quarters, is practically the same as last year.

The yield per acre of *Seeds' Hay* was 30·9 cwt., or 2½ cwt. above average and more than 7 cwt. heavier than in 1919. The acreage was also greater than last year and the total production, which amounted to 2,588,000 tons, exceeded last year's total by nearly 50 per cent. Crops of *Meadow Hay* were also good, the yield averaging 25·7 cwt. per acre, or 4 cwt. more than the decennial mean, and the best yield since 1907. The total production, 5,650,000 tons, is 2,230,000 tons greater than last year. Taking both kinds of hay

together the total crop is estimated at 8,238,000 tons, and slightly over 3,000,000 tons greater than last year. Farmers, therefore, have large stocks of hay for the coming winter, but it must be remembered that, owing to the very unfavourable weather at hay time, a large proportion was carted in a more or less damaged condition, and the feeding value is therefore not up to the usual standard.

The estimate of the hop crop was issued on the 26th October, and the estimates of the potato and root crops will be issued subsequently.

AGRICULTURAL RETURNS OF ENGLAND AND WALES, 1920.

PRELIMINARY STATEMENT showing the Estimated Total Produce and Yield per Acre of the CORN, PULSF, and HAY CROPS in England and Wales in the Year 1920, with Comparisons for 1919, and the Average Yield per Acre of the Ten Years 1910-1919

Crops		Estimated Total Produce		Acreage		Average Estimated Yield per Acre.		Average of the Ten Years 1910-1919
		1920	1919	1920	1919.	1920	1919	
ENGLAND AND WALES	Wheat	<i>Qr.</i> 6 677,000	<i>Qr.</i> 7,976,000	<i>Acres</i> 1 874 634	<i>Acres</i> 2,221,195	<i>Bush</i> 28 5	<i>Bush</i> 28 7	<i>Bush</i> 30 6
	Barley	6 336 000	5 474,000	1 637,166	1 609,716	31 0	29 0	31 2
	Oats	10 780 000	11 417 000	2 264 635	2 563 73	38 0	35 6	38 8
	Mixed Corn	605 000	622 000	146 346	112,235	31	35 0	—
	Beans	956 000	855 000	246 335	273 941	31 1	26 1	27 3
	Peas	444 000	441 000	129 325	132,249	27 4	26 7	24 9
	Seeds Hay*	<i>Tons</i> 2 588 000	<i>Tons</i> 1,769,000	1,574 512	1 501,253	<i>Cwt</i> 30 9	<i>Cwt</i> 23 6	<i>Cwt.</i> 28 4
	Meadow Hay†	5 650 000	3 417,000	4,395,258	4,170 509	25 7	16 4	21 7
	Wheat	<i>Qr.</i> 6 523,000	<i>Qr.</i> 7,728 000	1 824 086	2,160 281	<i>Bush</i> 28 6	<i>Bush</i> 28 8	<i>Bush</i> 30 7
	Barley	5 968 000	5,074,000	1 537 941	1,405,643	31 1	28 9	31 2
ENGLAND	Oats	9,848 000	10 052 000	2 015 477	2,261,558	39 1	38 7	39 2
	Mixed Corn	511 000	511,000	120 593	116 465	33 9	35 4	—
	Beans	949 000	847,000	244,477	271 481	31 1	26 0	27 3
	Peas	442 000	440,000	128,753	131,718	27 5	26 7	24 9
	Seeds Hay	<i>Tons</i> 2 329 000	<i>Tons</i> 1,600,000	1 495,219	1,342,131	<i>Cwt</i> 31 3	<i>Cwt</i> 23 8	<i>Cwt.</i> 28 8
	Meadow Hay	5 071 000	3,028,000	3,902,830	3 694,597	26 0	16 4	21 9
WALES	Wheat	<i>Qr.</i> 154 000	<i>Qr.</i> 248,000	50,548	70,814	<i>Bush</i> 24 5	<i>Bush</i> 28 0	<i>Bush</i> 27 3
	Barley	353 000	400 000	99,226	104 073	28 5	30 7	30 5
	Oats	914 000	1,368,000	249 158	312,175	29 3	35 0	35 1
	Mixed Corn	94 000	111 000	25 753	26,780	29 2	38 2	—
	Beans	6,900	7,800	1,858	2,460	29 5	25 5	27 3
	Peas	1 600	1,400	572	531	22 1	21 7	22 4
	Seeds Hay	<i>Tons</i> 259 000	<i>Tons</i> 169 000	188 293	139,122	<i>Cwt</i> 27 6	<i>Cwt</i> 21 3	<i>Cwt.</i> 26 3
	Meadow Hay	579 000	389,000	492 426	475,912	23 5	16 4	19 6

* Hay from Clover, Sainfoin, and Grasses under rotation

† Hay from Permanent Grass.

Egg Prices.—The Food Controller has issued an Order (No. 1972), dated 25th October, 1920, amending the Eggs (Prices) Order, 1919 (No. 1686 of 1919*). The General Licence dated 20th March, 1920 (No. 405 of 1920), issued under the principal Order, is revoked, and the following schedule of maximum prices substituted :—

<i>Description of Eggs</i>	<i>Other than Retail. At the Rate of</i>		<i>Retail. At the Rate of</i>
	<i>per Dozen.</i>		<i>per Dozen.</i>
	s.	d.	s. d.
Fresh eggs	5	4	6 0
Imported fresh eggs	5	4	6 0
Preserved eggs	4	5	5 0
Chinese eggs	3	7	4 0
Small eggs	2	8	3 0

The expression "eggs" includes the eggs of any bird, except plovers' eggs and gulls' eggs.

"Fresh eggs" means eggs produced in the United Kingdom each weighing $1\frac{1}{2}$ oz. or more, and not having been preserved either by pickling or by being held in cold store or otherwise.

"Imported fresh eggs" means eggs (other than eggs imported from China) imported into the United Kingdom each weighing $1\frac{1}{2}$ oz. or more, and not having been preserved either by pickling or by being held in cold store or otherwise.

"Preserved eggs" means eggs (other than eggs imported from China) each weighing $1\frac{1}{2}$ oz. or more, which have been preserved either by pickling or by being held in cold store or otherwise.

"Chinese eggs" means eggs imported from China, each weighing $1\frac{1}{2}$ oz. or more.

"Small eggs" means all eggs weighing less than $1\frac{1}{2}$ oz.

The expression "sale by retail" means any sale other than a sale to a person buying for the purpose of resale.

For detailed particulars of the terms and conditions applicable to transactions, the actual Orders referred to above should be consulted. Copies of these Orders may be obtained from His Majesty's Stationery Office, Imperial House, Kingsway, London, W.C.2., Price 1d., excluding postage.

Ministry's Exhibit of Varieties of Potatoes Immune from Wart Disease.—The exhibit of varieties of potatoes immune from Wart Disease which was staged at the Ormskirk (Lancs.) Society's Potato Show on the 27th and 28th October, will be shown at the following Agricultural Shows, in addition to those at which it has already appeared :—

Dalton-in-Furness Show	...	...	December 4th
Sheffield Show	...	...	" 11th
York Fat Stock Show	...	...	" 14th to 16th
Gainsborough Show	...	...	" 18th

Leaflets issued by the Ministry.—Since the date of the list given on page 786 of last month's issue of this *Journal*, the following leaflets have been issued :—

No. 356.—Mole Draining.

„ 358.—Fruit and Vegetable Drying (previously issued as Food Production Leaflet No. 9).

* See this *Journal*, January, 1920, p. 1033.

In addition, the information contained in the following leaflets has been revised and brought up to date :—

No. 72.—The Purchase of Artificial Manures.

„ 175.—The Use of Waste Organic Substances as Manures.

„ 285.—Bacon Curing on the Farm.

„ 298.—Pig Keeping for Cottagers and Small Holders.

Map showing Areas declared Infected with Wart Disease in Scotland.—The Ministry has issued a map showing those districts of Scotland which have been declared Infected Areas owing to the presence of Wart Disease in gardens and allotments. This map should assist potato dealers and others who desire to obtain “seed” potatoes from those parts of Scotland where Wart Disease does not exist.

Copies of the map (price 3d.) may be obtained post free from the Ministry's Offices at 3, St. James's Square, London, S.W.1.

Extension of the Rothamsted Laboratories.—It is proposed to extend the Rothamsted Laboratories at an early date so as to make much needed provision for the investigation of diseases and pests of farm crops which now cause much loss to the agriculturist. As a first step in the extension the Rothamsted Trustees propose to acquire a house and garden which occupy a large part of the island site on which the laboratories stand, and which the owner is prepared to sell.

Half of the money required was contributed by the Development Commission out of the Development Fund : most of the remainder has been given by important firms and organisations connected with the supply of farmers' materials, and a few of the members of the Society for Extending the Rothamsted Experiments. Almost the full amount has now been collected, the sum of £237 only being still needed.

Plans for the new laboratories have been drawn up, and a commencement will be made as soon as building conditions become more stable.

The Rothamsted Trustees hope that those interested in agricultural investigation and research will aid the fund by sending subscriptions (To the Director, Rothamsted Experimental Station, Harpenden, Herts.).

Rothamsted Experimental Station.—The Right Hon. Lord Bledisloe, K.B.E., has been appointed Chairman of the Lawes Agricultural Trust Committee, Rothamsted Experimental Station, Harpenden, in the place of Sir John Thorold, Bart., who has resigned.

Closing of the Experimental Fruit Farm at Woburn.—The Woburn Fruit Farm, which was carried on from 1894 to 1918 by the Duke of Bedford, and subsequently with the aid of a grant from the Development Fund, administered by the Committee of the Rothamsted Experimental Station, is to be closed at Christmas, owing to the continued ill health of Mr. Spencer U. Pickering, F.R.S., rendering him unable to continue his experimental work on the Farm.

The Ormakirk Potato Trials, 1919 Erratum.—In last month's issue of this *Journal*, page 697, it was inadvertently stated that the Annual Report for 1919 of the Trials of Potatoes Immune from Wart Disease was obtainable from H.M. Stationery Office. This is incorrect. Applications for copies should be addressed to the Offices of the Ministry, 3, St. James's Square, London, S.W.1.

A description of this publication appears on page xvii of this issue.

Foot-and-Mouth Disease.—*Kent (Faversham District).*—On 26th October, just as the Ministry was about to withdraw all restrictions imposed on the movement of animals in connection with the outbreak of Foot-and-Mouth Disease at Baddlesmere, near Faversham, two further outbreaks occurred in the neighbourhood of Faversham, namely, one at Oare and one at Stone. As a consequence, it was necessary to reimpose restrictions over the usual area of 15 miles' radius, it being considered unsafe to make any modification of the usual practice in this respect, owing to the fact that an animal from the infected premises had recently been exposed in Sittingbourne Market. A further outbreak occurred at Oare on 2nd November, but since that date there has not been any spread of the disease. On 9th November the restrictions were modified as regards the outer portions of the district distant more than 5 miles from the infected places, and were entirely withdrawn from those outer parts of the area as from 16th November. The prohibition of movement now remains in force only in respect of the area lying within a radius of 5 miles of the infected places.

Suffolk (Woodbridge District).—On 19th November, the existence of Foot-and-Mouth Disease was confirmed on two farms in the occupation of the same owner, situated within about a quarter of a mile of each other at Martlesham, Woodbridge. The usual Order was at once issued applying restrictions to an area in Suffolk within a radius of 15 miles of the infected premises. No information is yet available as to the origin of the outbreaks.

Rabies.—*Wiltshire and Dorset.*—On 29th October an outbreak of Rabies was confirmed in a dog located at Shillingstone, near Blandford, Dorset. The premises were just outside the district originally scheduled on account of the outbreaks in Wiltshire, and it was therefore necessary to extend the area so as to include the district within a radius of 15 miles of Shillingstone not already within the controlled districts. On 16th November a further case occurred on premises near Fiddleford, near Sturminster, Newton, Dorset, about 4 miles from Shillingstone, and another on 19th November at Bishopstone, Salisbury. Thirteen outbreaks of Rabies have now been confirmed in this district since the original case on 14th August. In view of the improved position as regards the Wiltshire portion of the area, it was possible to contract the inner controlled area so as to comprise only the district lying within 5 miles of Wilton and Salisbury in which the majority of the cases in Wiltshire have been confirmed.

Glamorgan.—No further outbreak has occurred in this district, and in view of the fact that the disease has not spread from the kennels of the Glamorgan Hunt, in which it was originally confirmed on 11th September, the Ministry on 13th November contracted the scheduled district so as to comprise only the country lying within about 8 miles of Cowbridge.

Berkshire.—Only one further outbreak has been confirmed in Berkshire, namely, on 19th October, on premises at Caversham, in the Borough of Reading.

THE JOURNAL OF THE MINISTRY OF AGRICULTURE

Vol. XXVII. No. 10.

JANUARY, 1921.

NOTES FOR THE MONTH.

THE Ministry of Agriculture and Fisheries Act provides for the setting up of an Agricultural Council for England and a similar Council for Wales, together with an Agricultural Advisory Committee for England and Wales.

First Meeting of the Agricultural Council for England.

The Agricultural Council for England has now been constituted and in accordance with the Act, is composed of members appointed by the Minister, by the Agricultural Wages Board, by County Agricultural Committees and by Agricultural Committees of County Boroughs. The members appointed by the Minister include representatives of workmen engaged in agriculture, owners of agricultural land, tenants of agricultural land, women, representatives of the industry of Horticulture, and representatives of agricultural education and research. The members appointed by the Agricultural Wages Board include both representatives of employers and representatives of workers.

The first meeting of the Agricultural Council for England was held at Essex Hall, London, on the 9th December last. The Earl of Selborne, K.G., G.C.M.G., was elected Chairman. The Right Hon. The Lord Lee of Fareham, Minister of Agriculture and Fisheries, delivered an inaugural address, the text of which will be found at p. 912 of this *Journal*.

The Council then proceeded to elect members to serve on the Agricultural Advisory Committee for England and Wales. The Ministry of Agriculture and Fisheries Act provides that the members of the Council appointed by the Minister shall nominate five of their number as members of the Agricultural Advisory Committee of whom one shall be an owner, one a tenant of agricultural land, one a representative of workmen engaged in agriculture, one a woman, and one a representative of agricultural

education or research. The representatives of these interests elected to the Advisory Committee in the order named, were Lord Selborne, Mr. Henry Overman, C.B.E., Mr. George Edwards, M.P., Lady Mabel Smith, and Professor T. B. Wood, C.B.E., M.A., F.R.S.

The members of the Council representing the County Agricultural Committees elected the following gentlemen to the Advisory Committee:—The Right Hon Sir Ailwyn E. Fellowes, K.B.E., K.C.V.O., Mr. E. W. Langford, Alderman G. G. Rea, C.B.E., Lord Bledisloe, K.B.E., and Sir Douglas Newton, K.B.E. It was announced that the Minister proposed to appoint Mr. R. R. Robbins, C.B.E., as a representative of employers and Mr. W. R. Smith, M.P., as a representative of workers on the Agricultural Advisory Committee and Mr. Henry Overman, C.B.E., as Vice-Chairman of the Committee.

The object of the Advisory Committee is to advise the Minister with respect to all questions submitted to the Committee in relation to the exercise by the Minister of any powers or duties which do not relate to the industry of fishing. The Advisory Committee will be at liberty to make recommendations with regard to other matters affecting Village and Rural Industries.

The first meeting of the Advisory Committee above referred to was held on Tuesday, December 14th. This meeting was

**Meeting of the
Agricultural Advisory
Committee.**

specially convened to consider the low prices at present being realised by farmers for British wheat. The chair was taken by Lord Lee of Fareham, and the following members of the Advisory Committee were present:—Mr. Henry Overman, Mr. E. W. Langford, Mr. George Edwards, M.P., Lord Bledisloe, Professor T. B. Wood, Sir Douglas Newton, and Sir Ailwyn E. Fellowes.

The Committee represented to the Minister the difficulty which was at present being experienced by farmers in obtaining a market for their wheat, and they urged that all possible steps should be taken which would be likely to stimulate the demand for home-grown wheat. Various proposals were put forward and the Minister explained the steps which had already been taken in regard to the matter. The principal points which arose in the course of the discussion are given in the following correspondence which subsequently passed between the National Farmers' Union and the Ministry.

THE following letter, dated 15th December, 1920, was addressed by the National Farmers' Union to the Minister of Agriculture:—

**Correspondence
with the National
Farmers' Union as
to Prices of Home-
Grown Wheat.**

My Lord,—At a meeting of the Council of the National Farmers' Union held this day, by the courtesy of the Royal Agricultural Society of England, at No. 16, Bedford Square, W.C.1, the following resolution was unanimously passed:—

“ The National Farmers' Union beg to call the attention of the Minister of Agriculture and the Food Controller to the difficult position in which farmers find themselves in disposing of their wheats.

“ On March 11th last, the Prime Minister announced in the House of Commons that the Government had decided that so long as wheat was controlled and thereby deprived of a free market the controlled price of home-grown wheat of sound milling quality should be the monthly average c.i.f. price of imported wheat, provided that the price so paid should not exceed 95s. per quarter of 504 lb.

“ Up to this date, the average monthly price of imported wheat, according to the purchases of the Wheat Commission, have exceeded 102s. per quarter of 480 lb., and the time has not, therefore, arrived when the British farmer should be required to take less than 95s. per quarter for his sound milling wheats; yet on Mark Lane on Monday last, prominent millers were quoting 80s. for the choicest samples of native wheats.

“ Farmers who have threshed their wheats have done so in reliance upon the announcement of the Ministry of Food, published on the 18th September last, informing them that they had nothing to gain by holding them.

“ There is no immediate prospect that the position will improve. On the contrary, there is the danger that it will grow worse.

“ With a view, therefore, to assisting the farmer to obtain the price which he has been led to expect, the National Farmers' Union make the following proposals:—

“ 1. That millers should be required for a period of one month to use an admixture of 20 per cent. of English wheat.

“ 2. That the percentage of extraction should be again lowered so as to encourage the use of native wheats.

“ 3. That the free export of wheat for the continent be permitted.

“ 4. That millers making flour from native wheat should be permitted to sell the flour at a price lower than the flat rate prescribed by the Food Controller.

“ 5. That the Cereals (Restriction) Order, 1919, be withdrawn so that farmers unable, in spite of the above concessions, to market their produce may feed to stock as in pre-war days.

“ The National Farmers' Union respectfully record their opinion that if the functions of the Wheat Commission as now exercised in relation to mills were discontinued, farmers would, under the influence of free conditions, have little difficulty in obtaining readily the assured maximum price of 95s. until such time as the reduction in the cost of imported grain compelled them to take less.”

I am, &c .

(Sgd.) A D ALLEN,
General Secretary.

The Right Hon. The Lord Lee of Fareham.

The following is a copy of the Ministry's reply:—

17th December, 1920.

Sir,—I am directed to refer to your letter of the 15th inst , forwarding a resolution passed by the National Farmers' Union with reference to the price of wheat and to say that the Minister has already given careful consideration to the question of the prices now being realised for British wheat and has taken steps in regard to several of the proposals referred to specifically in the Resolution.

1. With reference to the proposal that millers should be required for a period of one month to use an admixture of 20 per cent. of English wheat, I am to say that the Minister is advised that the proportion of English wheat used is on the average approximately 18 per cent., and that in the opinion of the Flour Mills Control Committee no substantial benefit would be obtained by prescribing a fixed proportion in all cases.

2. With regard to the percentage of extraction, I am to point out that the rate of extraction has recently been lowered from 76 to 75 per cent. In response to representations from this Department, the Ministry is informed by the Flour Mills Control Committee that a new rate will come into force on the 20th December by which the extraction will be still further lowered

to 78½ per cent. and to 72 per cent. if more than 15 per cent. of British wheat is used. The Minister is advised that in the opinion of the Flour Mills Control Committee this rate affords ample inducement to millers to use the maximum quantity of British wheat.

With a view to emphasising the importance of this matter, however, a letter has been addressed to the Wheat Commission urging that continued attention should be given to this point with a view to the rate of extraction of British wheat being kept proportionately low as compared with foreign wheat.

3. With regard to the free export of British wheat, representations have been made to the Wheat Commission with a view to the export of wheat for seed purposes being allowed without any restriction other than the issue of a licence on the recommendation of this Ministry. It is hoped that it may be possible to give effect to this proposal at no very distant date, though at the moment it is not possible to give any definite assurance on the point.

4. The suggestion that millers should be permitted to sell flour made exclusively from British wheat at a price lower than the controlled price of ordinary flour has also been submitted to the Food Controller with an urgent request that it may receive favourable consideration. The Ministry has, however, reason to doubt whether it will be possible to give effect to this proposal.

5. As regards the Cereals (Restriction) Order, the Minister is informed that this Order has been revoked by the Food Controller and that a notification to that effect is now being issued.

6. Lord Lee trusts that the National Farmers' Union will realise from the information given above that every possible step is being taken by this Ministry to assist farmers in securing a better market for home-grown wheat.

At the same time, he feels bound to remind the Union that millers are under no obligation to purchase grain which is not required to meet current needs, and that in a number of cases the relatively low prices which have been realised have been due to farmers pressing millers to purchase wheat to an extent which is in excess of current milling requirements. Another important cause of the low prices realised has been the inferior condition of much of the wheat recently offered for sale.

That there is at the present time a lack of demand is undoubted, and this appears to be partly due to a slow demand for flour by bakers, while in addition farmers have threshed heavily this season, with the result that millers hold large stocks of British wheat.

7. In this connection, I am to observe that the Notice issued by the Ministry of Food, referred to in the fourth paragraph of the Resolution, is presumably the one dated September 16th (P.N. 1181), of which a copy is enclosed. Whilst this Notice was certainly intended to discourage farmers from hoarding wheat until after next March, it can hardly be interpreted as an encouragement to thresh exceptional quantities of wheat in the early part of the season.

8. In conclusion I am to say that Lord Lee notes the opinion expressed in the final paragraph of the Resolution, and that he shares the desire of the National Farmers' Union for the removal of the control of wheat at the earliest possible moment.

I am, Sir, your obedient Servant,

(Sd.) F. L. C. FLOUD,

A. D. Allen, Esq., O.B.E.,

Secretary.

General Secretary, National Farmers' Union.

* * * * *

THE following Notice was issued by the Ministry to the Press on the 10th December, 1920 :—

The Price of Home-Grown Wheat.

The Ministry thinks it desirable to draw the attention of farmers to the fact that although recently there has been a considerable fall in the price of wheat in America and elsewhere, the present level of world's prices is still such that the price of British wheat of sound milling quality ought not to be affected.

Millers have been directed by the Food Controller that they have authorisation to pay for home-grown wheat of sound milling quality purchased on rail at producer's station, an average price not exceeding 95s. per 504 lb. f.o.r. or 96s. per 504 lb in respect of wheat delivered by road into the mill. Further, millers have been offered every inducement to use the maximum quantity of home-grown wheat, but in most cases flour containing a large proportion of imported wheat is required by bakers and householders.

It should be remembered that the miller is under no obligation to purchase grain which he does not require to meet immediate needs. The Ministry understands that much of the home-grown wheat which has been offered for sale by farmers during the past two weeks has been either of inferior quality or in doubtful condition, with the result that the full price payable for sound milling wheat has not been realised, while in addition farmers have in many cases been pressing millers to purchase wheat to an extent which is in excess of current milling requirements.

THE ENCLOSURE OF OPEN-FIELD FARMS.

THE RIGHT HON. LORD ERNLE, M.V.O.

In a previous article on this subject, published in last month's issue, Lord Ernle dealt with the general question of the enclosure of common land in this country from the agricultural point of view, and pointed out that English history records two great periods of enclosure: (1) 1485-1560; and (2) 1760-1820.

AGRICULTURALLY, the main objection to the ancient system of common cultivation was its want of flexibility. Under its rigid rules, the methods of farming and the use of land remained for centuries unaltered. But nature defies human regulations. One great change was in progress, and that was the declining fertility of the open-field farms. A holding of 15 arable acres—and the majority were probably less—which had in the 13th century provided the necessary food for a family, failed to produce it 200 years later. The virgin richness of the soil was long ago exhausted; year after year much had been taken out and little put back; considerable tracts of land could no longer be profitably tilled for corn. Reliable statistics are not available on so extensive a scale as to demonstrate in conclusive fashion the degree to which the yield had declined. But such figures as can safely be used seem to show that, even on demesne lands, the produce of wheat per acre had fallen from the neighbourhood of 10 bushels in the 13th century to between 6 and 7 bushels in the 15th century*. They also suggest that a smaller area was under wheat; in other words, that only the best soil was tilled for corn, and that inferior land had dropped out of arable cultivation because it no longer produced enough to make tillage profitable. If this was happening on the enclosed demesnes of churchmen like the Bishop of Winchester, managed with the highest farming skill of the day, it is not unreasonable to infer that the open-field farms were at least in no better

* On the demesnes of the Bishop of Winchester wheat was grown in 1208-09 on 6,898 acres, and in 1396-97 on 2,366½ acres. On the Manor of Whitney, a similar decline is marked from 417 acres in 1209 to 51½ in 1397. The yield in 1397 was on the Winchester land 6 bushels, and on the Whitney land 6½ bushels, to the acre. The 13th century work on agriculture, known as Walter of Henley's *Husbandry*, calculates the expected yield of wheat per acre at 10 bushels.

plight. It is extremely improbable that the lands enclosed for the private use of manorial lords were naturally inferior to those left in common cultivation, and the folding rights of the manor secured the largest and most concentrated supply of manure to the demesne. Where land was in several occupation, tillage could be converted into pasture and *vice versa*. Under the rigid system of common cultivation, no such change was possible. Once under the plough always under the plough was the rule. Though no figures are recorded to show the yield of open-field farms, it is natural to suppose that the decline in production was as great, if not greater. To the smaller partners in the association the failure of fertility meant progressive destitution. They had no means of arresting the decline, which showed itself in the abandonment of portions of ploughland, and the frequent appearance of "leas" in the midst of the arable fields.

Evidence exists to show that in the 15th century many holders recognised the hopelessness of their prospects by their refusal or reluctance to take land. From natural causes the open-field system was breaking down. Soil exhaustion was squeezing out the smaller men. A man with 15 arable acres, yielding 10 bushels to the acre, had, deducting seed, a bread supply for five persons from the 5 acres annually under wheat. If the yield was reduced to 5 bushels or less, the bread corn only sufficed for two and a half persons. Much of the poverty and misery of the rural population in both the great periods of enclosures may be fairly attributed to the decreased productivity of the land, though before the later period the peasant had been able to supplement the scanty yield of the soil by the money earnings of his domestic industries. When these handicrafts were swept into factories, the open-field system, unless it could be so modified as to allow the adoption of new agricultural resources, was doomed to disintegration by its own inherent defects.

It is only just that this central agricultural fact should be borne in mind in approaching either of the two great periods when the continuous process of enclosure excited the strongest criticism. In 1485-1560 the only remedy for the exhaustion of fertility was the conversion of the worn-out arable land into pasture, and the substitution of existing grass-land for the necessary tillage. In 1760-1820 there was an alternative remedy. It lay in the adoption of the newly-discovered resources of the farmer, and the introduction of clover,

temporary grasses and roots, and the application of the more abundant manure which the increased facilities for stall feeding in the winter months provided. In the earlier period, the first remedy was adopted, in the later period, the second. In both the agency was enclosure, either of a part of the land or on a scale which involved the break up of the agrarian partnerships. Commercial motives, no doubt, operated to accelerate both changes. There was money to be made by enclosures. But from the economic point of view the movement was necessitated by the national interest in the maximum yield from the soil of the country.

Within the framework of the open-field system, enclosure was at work. The weaker men were dropping out, and the more substantial men were taking up the vacated holdings. By arrangement among the tenants there was also an interchange and consolidation of intermixed strips. In both cases the change was often followed by piecemeal enclosure for separate use, either temporary or permanent. But the process was so slow that it excited little comment or apprehension, though its social effect was to increase the growing number of landless men. The smaller holders who were able to survive, did so through the common rights of pasture. If their arable strips yielded little or no produce, their retention, though untilled, carried with them the right to pasture their live stock. Even where a man had vacated his arable holding, he still clung to the privileges which it had conferred, especially the common shackle in the stubbles of the open fields. Many of the common rights thus exercised were a breach of the open-field system, and had their origin in sufferance or encroachment.

It was not till the period 1485-1560 that the enclosing movement, long in progress, reached a height which alarmed the country. The ephemeral literature to which it gave birth must be taken with the proverbial grain of salt. There was much exaggeration as well as truth in the description of its social consequences. The contemporary explanation, widely disseminated, was that the progress of enclosures, and the extensive conversion of tillage to pasture, were due to the greed of landowners. Tempted by the high prices of wool, so ran the charge, the landowners, and especially the new ones, evicted the open-field farmers from the arable land, meadows and common pasture of the village farms, and turned the whole into sheep walks. A shepherd and his dog took the place of

populous hamlets. Sheep, "that were wont to be so myke and tame, and so smal eaters," turned into devourers of human beings :

"They have eate up our medows and our downes
"Our corne, our wood, whole villages and townes ;
"Yea, they have eate up many wealthy men,
"Besides widowes and orphane children."

The occasional truth of this picture is confirmed by the eloquent pen of Sir Thomas More in his *Utopia* (1516). That the result of enclosures of a wholesale and drastic kind was depopulation cannot be disputed. In particular instances the popular charge was true. It may be questioned whether those instances were typical or exceptional. At this distance of time it is difficult to give any certain or definite answer. But the evidence collected by the Commissions of the 16th and 17th centuries goes to show that enclosures of whole townships were rare. The period coincides with the break-up of feudal households, the Dissolution of the Monasteries, and industrial reconstruction. A flood of pauperism swept over the country, and no doubt agricultural changes contributed to its volume. Numerous insurrections attest the discontent of the rural populations. It suited the dominant political party to emphasise the agrarian causes and to ignore those which originated in the vast religious changes that were taking place.

It may also be worth while to notice the nature of the motive to which enclosures were attributed. It was alleged that, owing to the great development of the woollen manufacturers in the early Tudor period, the price of wool rose to such a height as to encourage the abandonment of corn-growing for sheep-runs. No doubt commercial motives of this nature accelerated enclosures. But if, during the period when enclosures were proceeding most rapidly, the price of wheat remained relatively higher than that of wool, some additional reason other than trading profit must be found for the conversion of arable into pasture. That reason, it is suggested, is supplied by the exhaustion of the existing corn-land, especially on open-field farms, and by the necessity of restoring its fertility by a prolonged rest under grass. Thus sheep were as much a by-product or result of enclosure as they were its direct object or cause. This view is confirmed by the trend of prices. Enclosure of a piecemeal kind had been going on throughout the 15th century; it received a great expansion in the forty years following 1485, and took, more and more,

the shape of grass and sheep farming. Was the rise in the price of wool, relatively to that of wheat, so great as to afford a sufficient temptation to make the change? During the whole of the period 1270 to 1430, the price of wool had been consistently higher than that of wheat. But from 1430 to 1540—the period during which the progress of enclosures excited most alarm, and was attributed to the superior profits of sheep farming—this relation was completely reversed, and the price of wheat, in every decade but one, was higher than that of wool. It is true that in 1541-50 the price of wool suddenly soared high above that of wheat, but that was after the original force of the movement was to some degree spent. The general trend of prices seems to show that the usual explanation of the immense profits derived from sheep farming will not satisfactorily account for the extension of pasture. Some other reason must have lain behind the movement. It is submitted that that reason was agricultural, and is to be found in the exhaustion of the existing tillage land, and in the consequent difficulty of maintaining the open-field system.

The following table* of the decennial average prices of wheat and wool for 1361 to 1561 illustrates the foregoing statements.—

	Wheat per qt.	Wool per tod.
1361-70	7. 3½	9. 3
1371-80	6. 1½	10. 11
1381-90	5. 2	8. 0
1391-1400	5. 3	8. 4
1401-1410	5. 8½	9. 2½
1411-20	5. 6½	7. 8½
1421-30	5. 4½	7. 5½
1431-40	6. 11	5. 9
1441-50	5. 5½	4. 10½
1451-60	5. 6½	4. 3½
1461-70	5. 4½	4. 11½
1471-80	5. 4½	5. 4
1481-90	6. 3½	4. 8½
1491-1500	5. 0½	6. 0½
1501-10	5. 5½	4. 5½
1511-20	6. 8½	6. 7½
1521-30	7. 6	5. 4½
1531-40	7. 8½	6. 8½
1541-50	10. 8	20. 8
1551-60	15. 3½	15. 8

It is not disputed that the extension of sheep-farming was one of the causes of enclosures in 1485-1560. But it is argued that in many cases sheep-walks were themselves the effect of an underlying cause, namely, the decline in the productivity of

* The table is taken from *The Enclosures in England and Economic Reconstruction*. By Harriet Bradley, Ph.D. New York, 1918.

the soil. The only remedy lay in the restoration of the fertility of the exhausted arable land by conversion to pasture. The legislature endeavoured to cope with the situation by a series of Acts of Parliament directed against engrossing and enclosing. Engrossing meant the accumulation of holdings in the hands of one man. The law attempted to check an economic process which was the inevitable answer to exhausted fertility by preventing any individual from holding more than one farm. The word "farm," which originally meant the stipulated rent for an area of land, had not yet acquired its present meaning of the area of land out of which the rent issues. It was in the transition stage of meaning the definite area of land which afforded a living to a man and his family. It is in this sense that the word is used by Tudor legislators. The caution is necessary, because engrossing in the 16th century had a different meaning from that which it might now bear. The practice, with which we were unfortunately so familiar thirty years ago, of throwing several farms together, amounting in the aggregate to several hundred acres, might be called engrossing. But nothing on that scale was in the minds of Tudor legislators. They meant the additional occupation by one individual of the 10, 15 or 30 arable acres which had once afforded a living to another partner in the open-field farm. They did not inquire whether the area would still have afforded a living. They clapped a plaster to the sore, instead of attempting to remedy the sore itself, which was the exhausted fertility. In a similar way they dealt with enclosing. It was easy to pass an Act of Parliament that the open-field system must be maintained, and that the arable land must be retained under the plough. But, if the land did not return a living under tillage, the Act was a dead letter. At the time it was a frequent complaint that the legislation proved ineffective to check the progress of enclosures. One of the principal reasons why so little attention was paid to the law was that it provided no remedy for the evil it proposed to prevent. It was therefore as powerless as a Pope's Bull against a comet. It was not until the close of the 16th century that this fact was officially recognised. Alderman Box, in 1576, wrote a remarkable memorial to Lord Burleigh, in which he urges the folly of attempting to force men to continue to grow corn on exhausted arable. Twenty years later the principle found legal sanction. A statute at the end of the reign of Elizabeth (1597) recognises the agricultural difficulty. Men were relieved from the penalties attached to the conversion of tillage to grass if

they laid down arable to pasture with the "intente" that such "Grownde shall recover Harte and Strengthe." The change was welcomed by an agricultural member of the House of Commons in the debate on the Bill. "For it fareth with the earth," he says, "as with other creatures that through continual labour grow faint and feeble-hearted, and therefore if it be so far driven as to be out of breath, we may now by this law resort to a more lusty and proud piece of ground while the first gathers strength And this did the former lawgivers overslip, tyeing the land once tilled to a perpetual bondage and servitude of being ever tilled." Even in Tudor times it would seem that Parliament sometimes misunderstood or neglected agricultural difficulties.

It would be interesting to trace the influence of soil on the progress of enclosure. If, for instance, it could be established that the lighter soils were the first to be enclosed, and that, where the soil was deep and rich, the open-field system retained its hold, the view that soil exhaustion was one of the principal causes behind the movement, would be strikingly confirmed. It is obvious that the loss of fertility would be first felt on the lighter land, and that the richer soils would hold out longest. Much evidence might perhaps be quoted in support of this opinion. But there was so little uniformity in the movement, and it was affected by so many other local considerations, that any generalisations would be unsafe. New industrial districts were opening out as woollen manufactures developed; towns were increasing in size; means of communication were improving. Agriculture could not, in these changing circumstances, long continue in the self-supporting stage to which open-field farms were adapted. It was no longer enough that producers should feed themselves. Surplus produce was needed for the support of industrial districts and urban populations. Before the end of the 16th century much of the old arable acreage which had been enclosed and rested as grass was brought back into tillage, and the process of reconversion continued throughout the following century. New land was also brought into cultivation. Where it was reclaimed from forests, it did not interfere with village farms. But when it meant the improvement of common and waste, over which an association of village partners exercised common rights, it struck a fatal blow at the older system. It cut at its root. It deprived the village farmers of privileges which were essential to the tenure of their arable holdings. It was the principal cause of the rural discontent of the 16th and

17th centuries, so far as it was agrarian in its character. It may have become necessary in the national interest; but the land might have been brought into cultivation with less loss to the commoners. The point is social and legal rather than agricultural. But the suggestion of Alderman Box, to whose interesting memorial reference has been already made, was worthy of consideration. He advocates whole-heartedly the cultivation of wastes, but he lays his finger on the difficulty. While the wastes existed, the herbage and other smaller profits were shared by the manorial lord and his commoners; when they were brought into cultivation, the division was at the pleasure of the lord alone. He therefore suggests that the lord and four or five of the gravest tenants, selected by their fellows, should divide and allot the land in proportion to their existing holdings, each allotment to be conditional on its being brought into cultivation within two years.

If the counsel of men like Box had been in some form followed, a bitter controversy and a great social loss might have been avoided. Similar advice had been offered by Fitzherbert, the father of English agricultural literature (1529). It had also been given in one of the most striking economic treatises of the 16th century, *The Compendious or Briefe Examination*, attributed to John Hales (1549). If "everie man," says the Doctor in the dialogue, "that had Right to commen, had for his portion a pece of the same to himselfe Inclosed, I thincke no harm but rather good should come" from enclosure. The demand for "three acres and a cow" has a most respectable antiquity. Thomas Becon (1549) suggested that landlords should attach to every cottage enough "land to keep a cow or two." On the same line followed Gabriel Plattes (1639). "I would wish," he says, "that in every Parish where Commons are enclosed, a corner might be laid to the poore mens houses, that everyone might keep a cow or for the maintenance of his familie two." Throughout the whole Stewart period the protection of the commoners was a commonplace of agricultural writers who advocated individual occupation. It was not enclosure, but its abuse, to which objection was mainly taken.

On purely agricultural ground the defence of the old system was rapidly breaking down. Fear of depopulation had not been the only motive which had inspired the early legislation against enclosures. Scarcely less important as a motive was dread of the loss of bread supplies by the reduction of land

under the plough. The fear was crystallised in the Elizabethan prophecy: "No balks, no corn"—in other words, that no grain would be grown on enclosed land. But alarm on this score soon proved to be a bugbear. The supply was greater than before. The area under corn rather increased than diminished. The yield of wheat per acre also rose on the new land brought into cultivation, and on the older arable when it was reconverted to tillage, until it is said to have reached 20 bushels. These results were recognised in 1619 in the appointment of a Commission to grant licences for the conversion of arable land to pasture. After referring to the old legislation on the subject, the Proclamation states that "the quantitie and qualitie of errable and corne lands at this day doth much exceed the quantitie that was at the making of the saide Lawe." It goes on to say that, as the want of corn "shall appeare or the price thereof increase, all or a great part of those lands which were heretofore converted from errable to pasture and have sithence gotten heart, strength and fruitfulness, will be reduced to Corne lands againe, to the greate increase of graine to the Commonwealth and profite to each man in his private." With occasional rises in price, due mainly to bad seasons, civil war, or currency disturbances, the supply of corn for the next 180 years was abundant, steady and relatively cheap, in spite of the growing population and the considerable export of grain which continued up to the beginning of the long war with France.

With ocular demonstration that corn-growing could and would flourish on enclosed land, the discussion of the open-field system enters on a new phase. Attention begins to be increasingly concentrated on the obstacles which village farms presented to the introduction of improved farming, and on the economic loss that they inflicted on the community by their waste of land. Agriculturally, the interest of the Elizabethan and Stewart periods lies in the numerous improvements in methods and in the increased resources which were suggested to farmers. This progress may even be said to date from Fitzherbert. Both he and Tusser (1557) were enthusiastic advocates of enclosures on practical grounds. Their writings show in detail many of the ways in which, even in the existing state of agriculture, open-field farmers were handicapped. But as a general rule they suggest no improved methods of farming. In only two points can Fitzherbert claim to belong to the new school, but both are important. He pleads for attention to

the breeding of live stock, and he shows his perception of the future of mixed husbandry and of the alliance between the sheep-fold and the corn-bin, or between the bullock-yard and the granary, when he says that the man who tries to grow corn without stock, or to keep stock without corn, must either be "a buyer, a borrower, or a beggar." But with the Elizabethan and Stewart writers the suggestion of new practices, new crops and new rotations are multiplied. Between 1577 and 1689 most of the changes which have revolutionised British farming in the 19th century were discussed and foreshadowed in agricultural literature. We have, for example, the field cultivation of rape, of "Trefoil or Burgundian Grass," and of turnips suggested in 1577. Lucerne followed early in the next century, and potatoes in 1664. We have, in 1594, the scientific manuring of arable and pasture discussed, a great variety of fertilising substances recommended, the waste of the valuable properties of farmyard manure condemned, and closed covered receptacles suggested. The value of Peruvian guano was recognised in 1602. The drilling of corn instead of broadcast sowing was urged in 1604, and a drill patented in 1634. Before the end of the 17th century the aid of science was invoked, and an Agricultural College demanded. Oil cakes, silos and ensilage had been observed in use abroad, and their introduction recommended. Drainage was discussed by Walter Blith in 1649, with a sense and sagacity which were unrivalled until the 19th century and Smith of Deanston. The abolition of "slavish customs, the extinction of vermine," and the recognition of tenant right, sound modern demands; but they were strenuously urged in 1649. Cumbersome antediluvian implements were condemned, and numerous inventions patented. The "reaping car," the double-furrow plough, the drill which made the furrow, sowed the seed and deposited the manure, show that agricultural pioneers were attending to machinery. Greater attention to stock breeding was recommended. Breeds of cattle are distinguished according to the purposes for which they should be bred: this is reckoned the best for meat, that for draught, that for milk. Similarly, sheep are distinguished by the quality of their wool. Pigs take a prominent place as being "the Husbandmans Best Scavenger and the Huswives most Wholesome Sink"; but as to breed no county has a better than its neighbour, unless it be Leicestershire.

Here are indicated by agricultural writers in the 16th and 17th centuries, some of the most important features in the

immense advance which was made in English farming from 1780 onwards. It is from this new point of view that open-field farms are discussed. New and formidable arguments are based on the new means of agricultural progress. On the arable land of open-fields, subject to common rights while fallow or from corn harvest to seed-time, it was impossible to introduce the new crops. Rotations were limited and fixed by immemorial usage. No individual could move hand or foot to effect improvements, without the unanimous agreement of the whole body of joint occupiers. If one man sowed turnips, it would be the live stock of the community that would profit. Better stock breeding was impossible when all the grazing was in common. The difficulties of drainage were enormously increased by the necessity of securing co-operation. To these new arguments must be added the agricultural condition of many of the village farms. The evidence on this point may be, to some extent, prejudiced, because it comes from the advocates of progress. But it is so uniform in tenor and character, so confirmed by previous experience, and so consistent with the natural results to be expected from the rigidity of open-field farming, that it must be allowed some weight. The yield of the arable land was comparatively small and poor in quality. The commons were "pest-houses of disease," and the live stock that were reared on them were dwarfed and undersized. Large quantities both of the arable and pasture were worn out. Many open-field farmers lived "worse than in Bride-well."

The argument drawn from improved methods and increased resources would have been more forcible if the suggested changes had been put in practice on enclosed land. For the farmers' reluctance to accept their advice agricultural writers were themselves frequently to blame. Their folly was often as conspicuous as their wisdom. Their promises were ridiculously extravagant. Moreover, several of them had failed in practical life. Tusser, "teaching thrift, never throve"; Gabriel Plattes, the "corn-setter" and inventor of a drill, is said to have died shirtless, in the streets of London, for want of bread. Arthur Young had failed twice in farm management, before he began his *Farming Tours* and his crusade in favour of large farms, long leases and capitalist farmers. Even Bake-well, of Dishley, the pioneer of scientific stock breeding, went through the Bankruptcy Court. Apart from the low standard of education and the isolation of rural districts, the contempt

of practical men for book farmers may be explained, if not justified. Until the test of experience had sifted the useful suggestions from the foolish, the farmer answered for his class when he replied to the suggestion that he should try clover, "Gentlemen might sow it if they pleased, but farmers must pay their rents."

What was wanted was a lead, and in the 18th century it was given by the landowners. They initiated experiments, and poured their money into the land. Farms were at great cost adapted to modern methods by new buildings, roads, fences and drainage. Much of the land was literally "made" during the period. A wave of agricultural enthusiasm rose with each decade of the period, until at last it swept over the country. The introduction of roots, clover and artificial grasses solved the problem of winter keep. It enabled farmers to carry a larger head of stock. More stock yielded more manure; more manure raised larger crops; larger crops supported larger flocks and herds, which were both better bred and better fed. The agricultural circle seemed to promise indefinite expansion.

It is not the purpose of this article to describe the agricultural revolution of the latter half of the century. But its effect on open-field farms is obvious. The stream of prosperity passed them by. They were, so to speak, mediæval backwaters. Unless their system was transformed, they could not adopt the improvements which, on enclosed land, were so marvellously increasing production. Yet still, so long as population remained stationary and food was abundant, the old battle was renewed again and again. On one side was pleaded the injury which the break-up of open-field farms and the partition of commons inflicted on small occupiers and commoners. On the other were urged, with ever-increasing force, the obstacles to farming improvements which were presented by open arable fields, the unprofitable use of land occupied in common, and the commercial and productive advantages of enlarged separate holdings. Much was still to be said on both sides. It remained a question of the balance of national advantages. In the early part of the century the open-field farms dropped out gradually and slowly. Inclosure Acts were now the recognised procedure in enclosing open-fields, commons and wastes. From the reign of Anne to the accession of George III their number was small, and some of the earliest included in the list were confirmatory of previous arrangements. - From 1760 onwards they rapidly multiplied under the pressure of necessity. England was suddenly becoming a manufacturing

country. Population was shifting to the North, and collecting into towns. From these new industrial centres, more and more loudly, rose the demand for food. Little room was left for an agricultural system which was only self-supporting. Some effort was made to adapt it to the changing conditions. An Act of Parliament in 1773 enabled a majority of partners in the agrarian association to compel the consent of the minority to adopt the new crops in their rotations. Here and there, but with extreme rarity, instances are recorded of the introduction of turnips and clover in open fields. The Act may not have been made known or pushed with sufficient vigour in rural districts. Anyhow it proved a failure. Enclosure was no longer a question only of social or agricultural advantage; it had become one of economic necessity. The pressure steadily increased in severity. It culminated during the Napoleonic War, when every pound of food became of national value. At the declaration of peace in 1815 the old system of common cultivation had practically disappeared, and the newer system of individual occupation was almost universally installed in its place. Socially the change was a loss; economically its justification is complete. Under the new agricultural system Great Britain had been enabled to keep pace with her expanding needs, and, out of her own agricultural resources, not only to stand the strain of 22 years of war, but in 1840 to supply bread and meat to a population which, as compared with 1760, had more than doubled. It was a task which, unless centuries of experience were reversed, could never have been accomplished by the ancient system of open-fields.

THE AGRICULTURAL COUNCIL FOR ENGLAND:

THE MINISTER'S INAUGURAL ADDRESS.

THE following is the text of the inaugural address given by The Lord Lee of Fareham, Minister of Agriculture and Fisheries, at the first meeting of the Agricultural Council for England, at Essex Hall, London, on 9th December, 1920:—

LORD LEE :—Mr. Chairman, my Lords, ladies and gentlemen; may I explain, first of all, that I am only here as a guest. I am not a member of this august body. It is, I think, a very proper provision of the Act that this Council should be an independent Council on which officials of the Ministry are in no way represented. But you have been kind enough to invite me here to-day, and I am proud to have this opportunity of addressing the first Agricultural Parliament that has ever been called together in this country. I entirely re-echo what Mr. Royce said when he suggested that this was really an historic occasion—certainly historic so far as Agriculture is concerned. Whilst this is, as I said, a Parliament, it is not a Parliament elected by popular suffrage. But it is representative in the best sense of agricultural thought and experience throughout the country; and I should like, if I may, to congratulate all those who have been selected by the County Agricultural Committees, and other bodies, to meet here to-day. I will have a word to say later about your responsibilities, but before coming to that I should like also, if I may, to add one word of congratulation to the Chairman, Lord Selborne for the unanimous call which he has received to-day to the Chair on the occasion of your first Meeting. If I may say so, it seems to me peculiarly appropriate that he should occupy this position to-day, because if any one person is responsible for the inception of this Council it is Lord Selborne and the Agricultural Reconstruction Committee over which he presided three years ago. In the Report of that Committee—and both the Report and recommendations, I venture to say, are also going to be historic in the annals of agriculture—he made the following recommendation: “It is advisable to state here that in our opinion the Agriculture Department of each country should, in carrying out its duties, act in constant consultation with a National Agricultural Council or Board which we hope may be formed so as to represent the progressive agricultural thought of the country and fulfilling analogous functions

to those attributed to the German Agricultural Council." I do not like to think that this Council has been designed on a German model, but at the same time we must not be above learning even from our enemies. I have been looking at that paper of Sir Thomas Middleton's on the German Agricultural Council. I am glad to say we have not adopted its colossal German name, nor do I hope that we shall have the honour that that Council had of being addressed at intervals by the Kaiser himself. But, ladies and gentlemen, there is one observation in that paper which I think we might lay to heart and it is this:—"The great respect which the German Agricultural Council enjoys to-day, not merely in agricultural circles, but amongst administrative bodies is due to the extreme thoroughness which is characteristic of its Meetings, its resolutions, and its publications." I think that is a model which we might not be ashamed to follow, even if it be of foreign pattern.

As I see the functions of this Council they are two-fold; at least, they would certainly have a two-fold advantage to agriculture, and to the State. In the first place, I think it is recognised now by everyone that it is very advisable that Government Departments, Administrative Departments, bureaucratic departments as they are sometimes described, should be kept in the closest possible touch with instructed public feeling and opinion with regard to the matters with which the Departments have to deal. I am sure they always try to do so, and have always tried to do so. But it is not always easy. The public view filters into them through many official channels, and they may not always get the real article. Therefore, I think it is in the first place of the utmost advantage to the Government Department concerned to have an opportunity of receiving regularly, and fresh from the source outside, instructed opinion with regard to the particular business of the Department; and there is no way in which that can better be done than by coming in contact frequently and regularly with a Council such as this representing the industry in every part of the country. On the other hand, I think it is an important thing for the public and those engaged in representing the interests of a great industry such as agriculture in this country, to come in contact with the Department and to realise, what sometimes is difficult to realise, the special difficulties with which any Government Department is confronted in doing its best for the industry for which it is responsible. Governments have their difficulties and their worries like other people. They are naturally more exposed to criticism, and

rightly, than the ordinary members of the public; but I personally do welcome this opportunity of the Department coming into contact with this Council in order that you may recognise our difficulties, and, I hope, the sincerity of our desire to assist the industry, even when we do not always do exactly what you wish. On the other hand, we shall get from you a direct expression of the wishes and views of the industry, and, if necessary, be able to explain to you face to face what we can do and why possibly we cannot go in the direction that you desire. Hitherto this contact between the outside and inside, if I may so describe it, has largely been conducted through the medium of parliamentary questions, and so forth; but I am sure you realise that in these circumstances the Government or the Department concerned is necessarily and officially on the defensive, and I am not sure that that is the best way of exchanging confidence and views. This is an entirely different method, and I think a much better one. For that reason, as I say, I greatly welcome on behalf of the Department the assistance and guidance of this Council.

These ideas, which I have ventured to outline, materialised in the Ministry of Agriculture and Fisheries Act of last year which set up this Council and which prescribed how it should be constituted. It consists, as you know, of two members from each County Agricultural Committee, six members from the Agricultural Wages Board, and 36 members nominated by the Minister, and that is the body which has met here for the first time to-day.

May I say at this point one word about the composition of the Council, and particularly with regard to the Minister's nominees. The duty was placed upon me by Parliament to select 36 members of this Council. It is true that there are certain statutory qualifications with regard to representation of certain branches of the industry, and so forth. Those, of course, I have strictly observed. But discretion as to selection was deliberately placed by Parliament in my hands, as the responsible Minister for the time being, and I have endeavoured to discharge that responsibility with due regard to all the interests concerned. I am aware that in so doing I have incurred—and I do not complain—criticism in some quarters, because the nominations I have made may or may not meet with the full approval of this or that interest. But, ladies and gentlemen, whilst that is a matter upon which I am quite prepared to receive criticism, I am not prepared to surrender my responsibility; but I say this, quite sincerely, that in making my selections I have been animated

only by the one desire to see that every section of the industry is adequately represented so far as the constitution of the Council will permit, and in making my choices I have considered the individual far more than I have considered any organisation. I attach much more importance to men than I do to measures or even, to organisations, and in the choices I have made I have tried to select those individuals who seem to me qualified, either by their special knowledge, experience and reputation, or sometimes by geographical considerations. I think it is important that the various parts of the country should be as well represented as possible, but I have been animated by these motives in making my choices and not by any consideration of whether individuals belong to this or that organisation. I am aware that I am exposed to criticism on that point, but I thought it just as well to explain to the Council at the start the principle upon which I proceeded.

I do not know whether it was expected that on an occasion of this kind I should make any statement to the Council with regard to agricultural policy. Let me say at once I do not propose to do so, because this is, after all, an inaugural Meeting. It is not a Meeting, and never will be a Meeting, called together for the purpose of hearing the views of the Minister of Agriculture, unless he is asked by the Council to give them on any particular question which you are inclined to discuss. It is, if I understand aright, your business to select the subjects which you wish to discuss and to call upon, when need be, the Minister of Agriculture, or any representative of the Department, to give you information, to explain what is being done, and to listen to any views and advice that you may be prepared to give. Therefore, I do not propose to say a word about agricultural policy to-day. You are aware what the agricultural policy of the Government is at the present moment. It is at present on the rack in their Lordships' House. It emerged breathless from the Second Reading last night, and my labours are by no means concluded. But there are many other questions affecting agricultural policy which will come up from now onwards, and this Council, I think, affords an opportunity for agriculturists of all sections to join together in considering and formulating what future policies may be in the interests of the industry. I feel certain that this Council, constituted as it is, and animated as it is, will, in all circumstances, put the National interest before any sectional interest of this or that side of the industry. You are, as you are well aware, a perfectly independent body, free

to express your opinions, free to arrange your own business and procedure, and in no way subject to my control. That does not preclude the closest possible co-operation between you and the Ministry and certainly anything that the Ministry can do to assist you in your deliberations will be most willingly done.

Now, ladies and gentlemen, there is one point to which I feel bound to allude. Up till now the Ministry has not had the assistance of any advisory body, or any body representing the new organisations of agriculture throughout the country; but there has been in existence one body which has performed a most useful function, if I may venture to say so, up to now, and that is the Federation of Agricultural Executive Committees. That was, it is true, an unofficial body, but it did represent in a sense a Council of Agriculture so far as it was possible to form one at that time. We have now an official statutory Council representing the County Agricultural Committees throughout the country, with delegates from every one of them, and I am frankly a little anxious as to what might happen if there were a division of authority between the Federation of Agricultural Executive Committees and this Council. It seems to me, if I may say so, that it will be very difficult for both bodies to exist at the same time, giving possibly contrary advice to the Ministry upon questions of policy. I have no power or desire to influence the decisions of an independent body like the Federation of Agricultural Executive Committees, though, of course, the Agricultural Executive Committees no longer exist, and I cannot help feeling that it would be perhaps wiser, and more calculated to produce a united voice in agriculture in the future, if the Federation of Agricultural Executive Committees allowed itself to be merged in this representative and statutory Council, so that agriculture on all future matters of policy should speak with one representative voice.

You are aware that under the terms of the Act this Council elects, or at least very largely elects, the Agricultural Advisory Committee which is to be a body constantly at the elbow of the Minister "to advise him with respect to all matters and questions submitted to them in relation to the exercise by the Ministry of any of its powers or duties with regard to agriculture, and with liberty to make recommendations to the Ministry with regard to other matters affecting agriculture or rural industries." That Committee, which is the Cabinet of your Parliament, is a body of the very first importance. As I see the future, you will have a Minister of Agriculture supported, on the one hand, by

this Council, and constantly advised by the Agricultural Advisory Committee, with regard to all technical and other agricultural matters; whilst, on the other hand, he will have, within the Department itself, his Administrative Council to advise him with regard to purely administrative questions. He will thus be supported, on the one hand, by agricultural experience, and, on the other hand, by administrative experience, each expressed in the terms of an Advisory Committee. The Agricultural Advisory Committee is intended by Parliament to meet frequently, at least once a month I hope, or as many times oftener as is desired, and will be presided over by the Minister himself.

Your first duty now is to elect your respective members of that Advisory Committee. With regard to that I wish to say this. Up till now the Minister has had to appoint, and there are now in being, a number of Advisory Sub-Committees on technical questions, and we shall have to consider a little carefully what the relation of those should be to the Central Advisory Agricultural Committee which will now be set up. One thing is quite clear in my mind, that those Sub-Committees must be closely in relation with, and indeed, I think, co-ordinated by, the Agricultural Advisory Committee which will represent you. That, however, is a matter which can be discussed with the Committee when it is constituted. I hope that when all this organisation is complete there will be an effective and workman-like chain of responsibility reaching all the way up from the Counties to the Ministry, which will have a very real influence and effect upon future policy and administration.

I see later on in your Agenda there is a question of the date of your next Meeting. It is not for me to say when you should meet or when you should not meet, but I am very anxious that this Council should have the earliest possible opportunity of expressing its opinions and that I should have the benefit of those opinions on the burning questions of the day as soon as possible. There is only one subject down for discussion on the Agenda paper to-day, and I venture to suggest very respectfully, although it is a matter entirely for you to decide, that having got over your more or less formal inaugural business to-day the next Meeting of the Council should take place very shortly, and that in the meantime subjects which are desired to be discussed should be sent forward in the form of resolutions or motions, so that the next debate, in fact the first real debate, on agricultural policy should not be put off for six months as is suggested. That is not my business, but it is an expression of my real and sincere

desire that I should have the advantage of hearing the views of this Council upon agricultural questions at the earliest possible moment.

Now, ladies and gentlemen, I have only this to say in conclusion, that I am most grateful to you for giving me this opportunity of welcoming you on the occasion of your first Meeting, and of assuring you once again, which assurance I am sure you will accept, that I want this to be a real Council, a real advising body; I do not want it to be in any sense merely a debating society. If it is your desire that on any future occasion or occasions I should attend in order to hear your advice or to give you an expression of the views of the Ministry on any matter. I shall be entirely at your disposal. When I say "I shall be" I mean not only myself, but all my staff at the Ministry will make it their business to come here and to give you every assistance and advice in their power. ("Hear, hear.")

LORD BLEDISLOE :—My Lord, before the Minister of Agriculture leaves us I should like to propose a sincere vote of thanks to him for his presence here to-day, and for the encouraging words with which he has inaugurated what he has so properly called the new Agricultural Parliament. There is one statement he made which I think must have brought a great sense of relief to the minds of many here present—that in spite of any appearances which the platform might convey to our minds it is his intention that this body shall be perfectly free as an Agricultural Parliament to express its own unfettered views on the subjects that come before it. I am quite certain, if I may tell his Lordship so, that he will derive more real benefit from our deliberations if we have a consciousness that we are free to deliberate according to our own ideas and on matters upon which we may entertain rather strong views without being in any sense dictated to from Whitehall. I take this opportunity of saying to Lord Lee that, although we may not all agree with all his views, we do recognise in him a real champion of the industry in which we are all interested. We all recognise his extreme courtesy, his obvious fairmindedness, and his great courage in dealing with somewhat difficult and sometimes very delicate questions. If I may say so, for myself, I hope we may always find presiding over the new Ministry of Agriculture as capable and able and fairminded a man as Lord Lee of Fareham.

Lord Lee referred to the Federation of Agricultural Executive Committees over which I have had the honour of presiding for the last two years. We have no desire to perpetuate our exist-

ence unless we can fulfil some really useful purpose, and the sole question is whether this new Council of Agriculture for England, and, of course, Wales too, will adequately cover the ground. If the Meetings of this body are sufficiently frequent, and if they are able to deal with all the administrative matters upon which representatives of the new County Agricultural Committees will naturally from time to time want to confer, I for my part shall certainly not advocate the perpetuation of a body which will only mean duplicating work and unnecessary overlapping. I might mention that we are in negotiation with the County Councils Association with a view to their possibly establishing an Agricultural Committee similar to their Education Committee which will be able to hold Meetings from time to time of representatives of the new County Agricultural Committees to consider purely administrative matters. So long as this body is prepared to consider administrative matters, well and good. My only fear is that it will find itself too large a body to enter into technical details concerned solely with administration. All I want to leave upon Lord Lee's mind is this: we do not want to perpetuate our existence for a single day if we can fulfil no real and useful purpose.

Mr. ROYCE :—My Lord, I should like to second, if I may, this vote of thanks to Lord Lee. I am sure Lord Bledisloe has so very clearly stated the feeling of this Council with reference to Lord Lee that any words from me cannot be useful, but I would like to say, so far as my personal knowledge of Lord Lee is concerned, in relation to agriculture I can re-echo every word that has fallen from his Lordship's lips; and although there are some people who do not quite agree with Lord Lee in some of his views, as, for instance, the ploughing of grass land, I am sure we are all united and are of one opinion in believing that he is absolutely devoted to the interests of agriculture, and that if at any time he is removed from the great position he now holds—I suppose Governments are not eternal—I hope in the interests of agriculture he will be succeeded by someone equally interested in and equally devoted to the interests of agriculture. .

LORD SELBOENE :—It has been moved and seconded that this Agricultural Council for England passes a vote of thanks to Lord Lee for his inaugural address.

(The resolution was put to the Meeting and carried with acclamation.)

LORD LEE :—My Lords, ladies and gentlemen, I am extremely grateful to you for the way in which you have received this resolution, to my friend, Lord Bledisloe, for moving it, and to Mr. Royce for seconding in such generous terms.

With regard to Lord Bledisloe's remarks may I say this. I admit with one solitary exception the composition of this platform, as he called it, might create the unfortunate impression that he mentioned, but may we look upon it in this light, that, always excluding my noble friend, the Chairman, this is not the platform but the dock, and, as is not unusual, the dock is elevated above the rest of the Court in order that the features of the criminals may be clearly revealed to all present.

With regard to what Mr. Royce said, I can assure him that the suggestion that I am possessed with a mania for ploughing up grass land is just as unfounded as it would be to say that some General whose business it had been to fight through the war was still animated by a mania for killing in times of peace. The two epochs are entirely different, and I trust my future conduct in this matter will be found proper to peace conditions.

A MODERN HERTFORDSHIRE FARM : AN EXAMPLE OF UP-TO-DATE METHODS.

THE farm of Birchfield lies about a mile north of Hatfield Railway Station, and is intersected on the eastern side by the Great Northern Railway. It occupies an area of nearly 600 acres, of which less than 100 acres are permanent pasture and about 480 acres are under the plough in regular course of cropping. Lying at an altitude of some 300 feet, the area consists of a flat table-land forming the watershed of the River Lee and the River Colne. Part of the drainage water is drawn to the one stream, and part to the other.

The soils on the east side of the farm are of poor quality, thin and gravelly, and in a dry season show a great tendency to dry out, with the result that the crops burn readily. The west side, on the other hand, is a mild brick earth of a depth of 4 feet in parts, and considerably closer in texture and much more retentive of water than the eastern side. The top formations overlie a thin bed of gravel, below which there is a deposit of blue clay that holds up and prevents the removal of the soil water.

The farm has had a somewhat chequered history, and even through the very favourable period before the more recent years of agricultural depression antecedent to the War, it was reported to be an unsound undertaking from a financial point of view. Much of the better land was in an undrained state, the ditches through long neglect were earthed up, the hedges overgrown and

constructed running practically through the centre from north

to south and from east to west. The farm buildings and home meadows lie centrally to the east of the road running north and south. Chiefly as a result of the wholesale removal of hedges the farm now presents an appearance very different from that which is general in the neighbourhood and indeed very characteristic of much of Hertfordshire. A block of nearly 400 acres of arable land is without a hedge; except for three self-contained fields of 9, 20 and 56 acres, respectively, the area lies in sections, averaging from 50-60 acres each, which are divided from each other by a furrow only.

The farm is run as far as possible on commercial, almost on factory lines. Intensive methods of cultivation are adopted, and the general "lay-out" has been planned to facilitate economy of working. The situation within 20 miles of London and near railway stations and sidings has naturally determined to a large extent the choice of crops grown in the rotation. The systems of cultivation followed furnish a very striking example of up-to-date methods of business farming. Full advantage is taken of the opportunity to produce those articles for which there is a constant demand in the local markets, and to obtain in return the material necessary to maintain the fertility which is lost in removing the crops. In the early years of farming under the improved system it was an easy matter to obtain stable manure from London at the low price of 2s. per ton on rail, and its extensive use on the land not only afforded a ready means of replacing the loss entailed by the continuous drain on the plant food materials of the soil but also assisted in putting the land in good heart and working condition.

The Rotation.—The rotation adopted is the four-course system of cropping, with potatoes occupying the fallow break. The order is potatoes, wheat, seeds, wheat and winter oats.

In the early years, as already stated, London manure was used in great quantity, as much as 40 tons per acre being applied once in the rotation preparatory to potato planting. It was found after eight years, however (*i.e.*, when the land had been twice gone over) that as a result of these high dressings the soft and luxuriant foliage was readily susceptible to potato blight, and that the white crop was very liable to lodge. The system was therefore altered, an application of 20 tons of stable manure, supplemented in the spring, at the time of planting, by a dressing of 7 cwt. of artificial manures, being given instead. A sounder crop of potatoes has been obtained as a result, and the cereals are stiffer in the straw, a matter of importance from the point



FIG. 1. General View of Birchfield Farm Steading

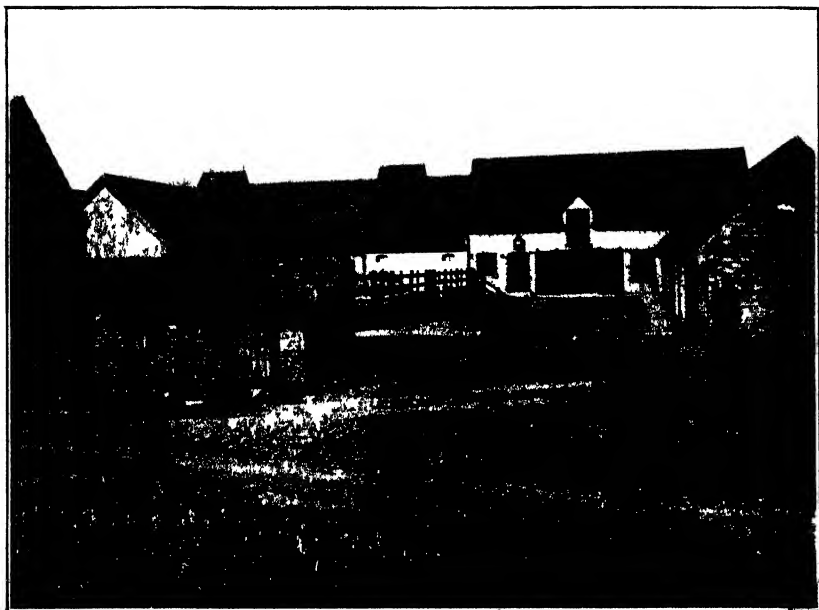


FIG. 2.—Near View showing Cowhouses, Dairy, Food preparing, Shed, Loose Box and Manure Court

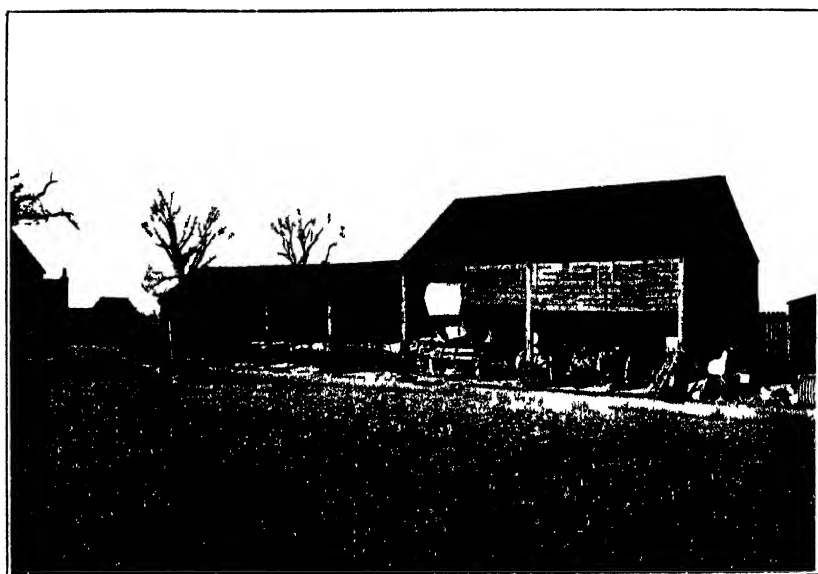


FIG. 3.—Implement Sheds

of view of ease in harvesting and obtaining the largest possible quantity of saleable grain.

Some eight years later sourness, resulting from the constant use of artificials in quantity, became evident, and to counteract this tendency a dressing of 10 cwt. of ground lime per acre is now applied in the rotation every four years. The ground lime is distributed over the rotation grass "break."

Potatoes.—Preliminary to planting, the stubble land is marked off over the entire area of the break into 6-yd. squares, by means of a plough, in readiness for the distribution of the farm-yard manure.

The expense of this operation is more than compensated for by the time saved in putting the heaps out and in effecting evenness of distribution. After the manure has been spread on the flat in this way autumn ploughing to a depth of 6 in. is carried out, followed by spring cross-ploughing to a depth of 8½-9 in. The land is then cultivated and harrowed and the drills (28 in. wide) are opened; a depth of 8 in. is the rule.* A dressing of artificials of the following composition is then sown:—

3 cwt. high grade superphosphate,
1 „ to 1½ cwt. sulphate of ammonia,
1 „ sulphate of potash.
†1½ „ steamed bone flour.

The potato sets are planted by hand 18 in. apart at a depth of 2½-3 in., and are covered in by a medium-weight plough.

A small quantity of the "seed" is boxed. Boxing is only necessary in the case of the later sown crops, which are planted towards the end of April, or, if the weather breaks, as late as May.

The whole crop is sprayed twice.‡ In the case of white-skinned varieties new "seed" is imported from Scotland annually. One year old "seed" of the King Edward variety is found to give as good results as seed obtained direct from the North. The varieties grown in 1920 were King Edward, Great Scot and Ally.

The yield of ware is usually from 6 to 10 tons per acre. A small quantity of seed size is sold, but as a rule all under ware size is used as cattle and pig food.

* For this purpose a combined furrow opener and manure sower by T. & R. Wallace is highly spoken of by the farmer.

† Steamed bone flour is included to dry the mixture and produce a friable, sowable condition.

‡ A strong and durable machine by T. W. Chafer-Doncaster is recommended by the farmer.

It is interesting to note the modifications in method that are induced by conditions that may be only fugitive in their operation. Some ten years ago the Up-to-Dates were suffering very badly from potato blight, and as much as 50 per cent. of the crop had to be sold as cattle food. The market was overstocked, and prices fell. It was therefore decided to take up the production of milk, which promised to be a more profitable undertaking, and with this view a complete range of new buildings was erected, including a shed for 40 cows. Fifty cows, with 40 in milk, were kept between 1909 and 1915. Milk, however, was very low in price during that period, and in the winter of 1914 a loss of £3 per week was being incurred, not taking into account depreciation in respect of the cows, management and interest on capital. The labourers were dissatisfied with the long hours, and an endeavour to improve conditions by the introduction of mechanical milking plant led to a reduction of the yield per cow, and frequently the udders were spoiled. The herd was therefore sold in September, 1915. By this time the price of waste potatoes suitable for cattle feeding only had risen, and it again became more profitable to sell rather than to use them on the farm. In view, however, of the scarcity of city manure, owing to the increased use of mechanical transport, it may be necessary to consider the desirability of the keeping of a larger number of stock, in order to obtain a sufficient supply of dung, so necessary for the potato crop.

Wheat after Potatoes.—A mid-early variety is grown as a main crop, as on stiffish land, such as at Birchfield, the best time of sowing may thus be secured. After the potatoes are off the ground ploughing is performed with a 5-6 in. furrow, and 2½ bushels of seed per acre are drilled in; a white chaff variety is sown on the heavier and better land, and a red chaff on the poorer soils. White chaffs give a low yield on the poor land, while the red chaffs will not stand on the richer soils.

Drilling on the tilth left by the potato diggers has been tried, but the practice is not favoured, as the succeeding crop is found to lack uniformity. Good results were obtained in a dry winter, but when the season was wet the land was lashed too tightly, and it was found almost impossible to obtain a good "plant" of clover. A dressing of 3 cwt. of artificials per acre in the same proportions as in the potato mixture (see p. 923), is given to all the wheat crops. Among the white chaff varieties grown in 1920 were Marshal Foch and Yeoman; the average yield per acre was 6½ quarters. Red chaff varieties are yielding 3½ quarters per acre.



FIG. 4 Farm Cottages

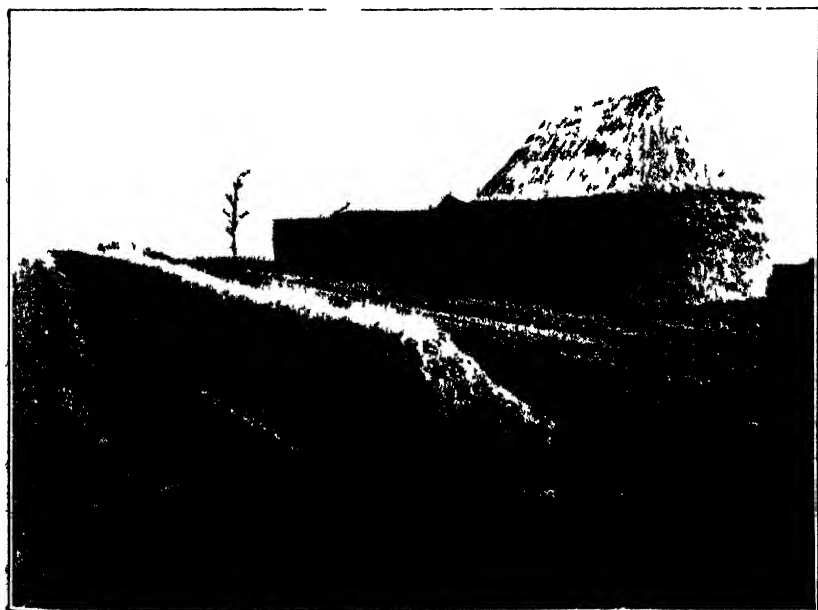


FIG. 5.—Method of clamping and stacking by sides of farm roads



FIG. 6—View looking west down farm road. Potato Clump bordering field of 75 acres.
Double furrow recently turned to provide second covering for Clump.



FIG. 7—Open view across field of Winter Oats showing clearance of trees and hedges.

Grasses and Clover.—The “ seeds ” mixture used was as follows :—

- $\frac{1}{2}$ bushel Italian Ryegrass,
- 8 lb. English Red Clover,
- 2 „ Alsike,
- 2 „ Trefoil.

The mixture is sown by barrow in April, harrowed in and rolled down. As mentioned above, 10 cwt. of ground lime is applied to the seeds break in early winter. The general custom in Hertfordshire is to grow pure crops of clovers only, or sainfoin only—the latter is popular on the chalks in the northern part of the county. By this means the same leguminous crop occupies the ground once in 8 years, and the danger of loss by clover sickness is greatly lessened. The addition of grasses to the mixture, however, which is a feature of “ seeds ” cultivation at Birchfield, does not find favour generally, as grasses encourage the wireworm. The tenant of Birchfield points out that this danger is only present when the crop is allowed to grow through the season with the object of a second cut of hay being taken. When only one cut is taken the land can be ploughed immediately—in July—and in this way the wireworm danger may be very largely overcome. The land may also be bastard-fallowed, and thus a further opportunity of cleaning is offered during the rotation.

Wheat and Winter Oats.—Half the break is sown with wheat, and half with winter oats. The dressing given is the same as for the wheat crop. In the case of the oats, 8 bushels of seed are drilled in. (Spring oats are very uncertain here, but when grown a seeding of 4 bushels is the rule.) “ Regenerated Grey Winter ” is the variety used at present; it ripens later by 8 to 10 days than the ordinary variety. The yield in 1920 is expected to be about 6 $\frac{1}{2}$ quarters. The proximity of London, with its enormous market for all kinds of produce and the availability of dung, has, as already mentioned, largely determined the system of farming adopted, but owing to the reduced supplies of this manure available it has been found more economical to sow leguminous plants with the white crop to provide the necessary fertility in readiness for the potato crop. White clover is ordinarily used, but of late years, in consequence of the high cost of that seed, Alsike and Trefoil have been substituted. The amount sown is 4-5 lb. per acre, and at the time of writing one field in particular is showing a close crop which will in due course be ploughed down as green manure. A serious difficulty in the

growing of this crop is the incidence of "Clover Sickness." The tenant is of opinion, however, that this trouble may largely be avoided by deep ploughing once in the rotation—in this instance by the very deep second or cross-ploughing of the potato-break in the spring.

Stock.—As much of the crop as possible, including hay and straw is sold off the farm, and only the working horses, and a few cattle to consume the offals that cannot be sold, are kept. Twelve horses are employed on the farm, except in autumn, when the number is increased to 16, and three tractors are now kept. No fewer horses can be kept than in the years before the War, as the additional machinery acquired is only sufficient to make up for the diminished labour due to the reduction in the working hours of labourers. The permanent pasture is grazed by heifers or fattening bullocks, 30 to 40 in all; a breeding sow and some store pigs and poultry complete the numbers of the live stock of the farm.

Farm Buildings.—A complete range of buildings suitable for the requirements of the farm was erected according to plans supplied by the tenant. The farm cottages are of modern construction and have gardens attached.

Machinery.—The most modern types of machinery and implements are used. Threshing is done by a Titan tractor and a 4 ft. 6 in. thresher. All stacks are built on the fields bordering the farm roads, to minimise time in stacking during harvest and to have the ricks isolated in case of fire. A trained blacksmith, provided with forge and workshop, executes all minor repairs. Various makes of potato diggers are employed. The opinion was expressed that there is a great future for the "Hoover" digger. At present, however, the lightness of its construction is a factor against it, necessitating its constant repair. It has a heavy draught, and the best results are obtained when it is drawn by tractor. Special attention is given to storing and the care of implements and machinery.

Labour.—A score of men comprise the permanent staff on the farm, and there is a good understanding between the farmer and his workmen. County rates of wages are paid. The young men seem to realise that shorter hours and high wages are only possible by working hard and efficiently.

In the special season of potato-lifting use is made of the local and casual labour available. The period of potato-lifting follows almost immediately the hop-picking time, and the same workers

come back to the farm year after year. Wages for lifters have risen considerably, the current rate being 1s. per hour. Twenty to 25 pickers are required for one digger, and each digger clears 3 to $3\frac{1}{2}$ acres a day.

The farm owes much of its success to the fact that the existence of an important and ready market has been recognised, and the crops selected to meet the demands of the market. Every effort is made to effect economies in working, and as far as possible the fields are arranged so that there is a minimum amount of time devoted to the changing of operations and implements between shift and shift. Birchfield, however, possesses two types of soil, and where, as in this case, two types of soil are present, any one crop must be so far distributed to reduce the risk of loss in any one season to a minimum, since conditions which may be detrimental on one class of soil may be quite the reverse on another class.

MOORLAND GRAZING : ITS IMPROVEMENT BY HEAVY STOCKING.

CAPTAIN ANTHONY THOMPSON, M.Sc., A.S.I.,

Assisted by Miss D. ANDERSON, B.Sc., N.D.A. (Hons.),
Armstrong College, Newcastle-upon-Tyne.

A STUDY of the measures which have been taken in the past for the improvement of moorland pasture makes it clear that a variety of problems is involved which cannot be solved by a single general remedy, whether manurial or mechanical. Disease, draining, and herbage alone of the many considerations which occupy the hill farmer's mind, may, together or separately, present difficulties which appear insurmountable, and each area needs to be considered on its own merits. The herbage on moorland is very different from that of the lowland pastures. It is the natural food of the stock and game it feeds, and vast areas in Great Britain are not likely to support any better plants. In such areas it would obviously be unsound to destroy the existing herbage, but there are areas capable of improvement, where the coarser hill plants can be made to give way to clover and better pasture grasses, and which, when improved, are of great value to the hill farmer. How far such improvement may be economically possible depends on the difference between the original and improved value of the land, together with the cost of treatment and the period required to effect it.

It appears that much of such herbage has become of a rougher nature since the change on many moors in grazing sheep instead of cattle.* The period during which this change took place varied considerably in different places, but whether it was comparatively recent or remote, there is no doubt that the effect on the land through the heavier trampling of the cattle tends to "fine" the turf and develop superior herbage. It is only necessary to observe the intakes on our moors and the land around gateways for this to be evident.

In Cumberland and Northumberland considerable areas of moorland are covered with a cloak of slowly decaying organic matter consisting of the remains of the natural herbage and its roots. This peaty covering lies on a variety of soils. In Northumberland it is called "fog," a somewhat confusing name, but

* Patrick B. Latham, "The Deterioration of Mountain Pastures, and Suggestions for their Improvement." *Trans. H. & A. S.*, 1883.

useful in the absence of a better. The "fog" has been and is the object of experiment.* Owing to its matted condition it prevents most artificial manures from reaching the soil beneath, and it would seem that the manures are carried away by surface drainage. The same character results in water being turned to a remarkable degree, and even though the "fog" absorbs a considerable quantity, making the surface very wet in rainy weather, the soil below not infrequently is found to be quite dry. Those plants, therefore, which are intolerant of the acid "fog," are denied proper nourishment from the soil itself.

These properties attributed to "fog" have been confirmed by the experiments in North Wales.† Basic slag in Northumberland, and lime in both Northumberland and Cumberland, have effected improvements, though but slowly, and roughly in proportion to the depth, and consequent resistance, of the "fog." Lime in other parts of the country and in Scotland has produced good results, but the post-war cost, including carriage and labour, appears to make its use prohibitive.

Where the "fog" is thin, manures will frequently give good results, provided that there is a suitable herbage to develop. If the resisting blanket of matted turf is reduced or broken up, improvement can be effected, but on account of the difficulty of the operations involved this is not usually a practical proposition. Records of ploughing out such land exist, and there is evidence that considerable portions were once in cultivation, for example, in the country of the North Tyne. On the whole, breaking up seems to be out of the question. The "fog," however, may be overcome by heavy stocking, and though this method is limited in the amount of land which can be captured from the rough moor, the importance of such additions to the better pasture of the hill farm can scarcely be over-estimated.

The interest of Alderman W. Dobson, C.C., of Howgate, Brampton, Cumberland, in the subject, makes possible the following account of improvement by heavy stocking. Alderman Dobson, until May last, was tenant of Tarn House Farm, situated a few miles from Brampton Junction. Cattle appear to have grazed Tarn House Rigg—an area of 300 to 400 acres, at between 800 and 900 ft. above sea-level—down to about 1840, being put on in the spring and mostly disposed of at autumn fairs. At that time much of the Rigg was under heather

* Capt. Anthony Thompson, M.Sc., "The Improvement of Moorland Grazing," *Jour. of the Newcastle Farmers' Club*, 1920.

† Reports on Experiments, 1917 to 1919; University College of North Wales.

which has since disappeared. The present herbage is stated in Column 1 of the Table on page 938. This Table was drawn up after a rough survey made in July of this year. The value of most of the plants noted was dealt with by Professor Wallace as far back as 1884,* and touched on more recently in his book on "Heather and Moor Burning." The amount of heather noted on the Rigg was very small, and the heather is evidently a new plant. The cross-leaved heather is rather more abundant. The "Blaeberry," as the Bilberry is known in the North, shows up here and there, and is more scattered than the two plants above mentioned. On the moors beyond and at heights of from 1,800 to 2,000 ft. is found the Cloudberry (*Rubus Chamæmorus*). The bulk of the herbage is made up of Flying Bent, Stqol Bent, and the Hair grasses. Draw-moss (Sheathing Cottonsedge) is abundant here and there, and Wire Bent is found to a slightly lesser extent. The common rush shows up in the wetter places. Bracken is present, densely covering a considerable area, and is spreading. The remainder of the plants indicated in Col. 1 are found in smaller amounts; of these, Crested Dog's Tail, Sheep's Fescue, Yorkshire Fog, Sweet Vernal and Annual Meadow Grass are most in evidence.

The list in Col. 1 was made during a walk over the Rigg, and some plants may have been overlooked, although a careful search was made for clover. None was observed. There is clover about half a mile away, where lime was applied fifteen or twenty years ago. As will appear below, clover has been developed in very considerable quantity on the thirteen acres of the Rigg which have been improved by heavy stocking. On similar moors in Northumberland, at about the same altitude, occasional clover plants are found, small and starved, appearing to be almost unequal to the struggle against the "fog."

Col. 2 gives the names of the plants which appear on the improved area. From a considerable distance away the plot stands out sharply defined from the surrounding Rigg, by reason of its fresh, green appearance. In July, when the botanical survey was undertaken, the contrast which this plot made against the brownish hue of the untreated moor was very noticeable. On entering the enclosure the abundance of wild white clover is most striking. This plant is making vigorous growth on almost all parts of the area, even pushing its way through clumps of Tussock where, in places, the vigour of this coarse grass has been

* "The Natural and Artificial Food of Scotch Hill Sheep." *Trans. H. & A. S.*, 1884.

checked by the cattle trampling on the Tussock or feeding on the young shoots. There are, indeed, few places where no clover is to be found, and patches consisting almost exclusively of this plant, covering several square yards, are not uncommon. Of grasses, Sheep's and Hard Fescue, Fiorin and Yorkshire Fog are the most abundant, while the Tufted and Wavy Hair-grasses are also present in some quantity here as on the untreated ground. Crested Dog's Tail is not very prominent. There is little Wire Bent, and the Flying Bent, so common on the surrounding Rigg, is here entirely absent (see Col. 2). Heath Rush (Stool Bent) is also absent, and while there is a fair amount of the common rush, this plant is practically confined to a somewhat wet corner of the plot. Bracken is creeping in from the surrounding Rigg at the eastern end of the enclosure. Creeping Buttercup and Creeping Thistle are somewhat conspicuous weeds over a large part of the area, and to a less extent the Stinging Nettle. Only one specimen of Dandelion was observed, while Cuckoo Flower and Self-heal were not numerous. It is worthy of notice that among the plants established on the enclosure there are several weeds which are not recorded as being found on the Rigg. These appear to stand no chance of growing where the Flying Bent is present.

No seeds were sown on the improved area, and the plants found on this land either survived the process of improvement, or their seeds were carried by natural agents. Some years ago, Alderman Dobson fenced off thirteen acres of the Rigg. A portion of this was tile-drained owing to its wetness, and the open "sheep drains" were filled in to allow the use of the mowing machine. Many stones were removed. Live stock was barred out in May, and in August or September as much as possible of the enclosure (of "Bent" grasses) was mown. The two latter months constitute the usual time of year for winning "Bent" hay. The hay was stacked on the plot.

During the next winter some twenty two-year-old Galloway cattle were kept in the field, in which there is a small spring. Earthenware troughs were set down some distance from each other, and cotton cake was fed to the animals in the morning, and "Bent" hay morning and evening. The ground was heavily trampled around the troughs and in places where the hay had been scattered. The winter rains helped the treading of the cattle by destroying the surface covering of coarse plants and matted roots. From time to time the cake troughs were moved to fresh positions, and by March or April considerable

areas had been trampled almost black, with much dung on the surface. These portions were heavily chain-harrowed with a Parmiter harrow, which levelled them and spread the manure.

In the following summer another crop of Bent hay was stacked in a different part of the field, and the process was repeated for several years, until, when the whole of the enclosure had come under treatment, a dressing of lime was applied. As a result the Flying Bent was destroyed and the "fog" disappeared. On a soil somewhat peaty in character a new herbage has arisen. The enclosure looks a veritable oasis, especially at those seasons when the moor beyond its fences turns brown and later greyish-white, due to the dominant *Molinia*. At a modest estimate the value of the field for grazing, acre for acre, is five or six times that of the surrounding Rigg. Improvement of a further area on these lines is being contemplated by the present tenant of Tarn House, and the method has been followed on other moorland in Northumberland.

When Dr. William Somerville, now Professor of Rural Economy in the University of Oxford, was Professor at Armstrong College, he attempted some experiments at Tarn House in the manuring of rough moorland. Ten plots, of $\frac{1}{3}$ th acre each, were laid out and dressed in 1895 with nitrate of soda, slag, superphosphate and kainit, applied separately and in various combinations. The plots were at an elevation of 800 feet and the "fog" was thick. The figures of cost of treatment for the period show a range of from 8s. 9d. an acre where nitrate of soda alone was used, to 16s. 9d. an acre where lime dust was applied together with slag and kainit. The reports were not encouraging, although small amounts of the dressings were applied annually for several years. It was observed that where kainit had been used, stock had eaten the herbage on the plot, probably because of the salt ingredients in the manure. In addition slag and kainit had caused an increased yield of herbage. By 1897, however, the effect of the manures was scarcely observable. Mr. Dobson, the tenant of Tarn House, states that when the plots were finally inspected no improvement of any kind was visible. The reason given by Professor Somerville was that the artificial manures had not been able to reach the soil, but were held up by the thick, matted, spongy covering of roots which overlaid it, and made manurial treatment of no avail. It was only by drastic and costly methods that any permanent improvement could be effected.

TABLE showing Plants present on Unimproved and Improved Moorland. Plants present indicated by a X.

		Col 1. <i>Unimproved Moorland</i>	Col 2 <i>Improved Moorland.</i>
<i>Ranunculus repens</i>	Creeping Buttercup		X
<i>Cardamine pratensis</i>	Cuckoo Flower		X
<i>Polygala vulgaris</i>	Milkwort	X	
<i>Potentilla Tormentilla</i>	Tormentil	X	X
<i>Stellaria media</i>	Chickweed		X
<i>Cerastium triviale</i>	Mouse eared Chickweed	X	X
<i>Trifolium repens</i>	Wild White Clover		X
<i>Galium saxatile</i>	Heath Bedstraw	X	X
<i>Taraxacum officinale</i>	Dandelion		X
<i>Cnicus lanceolatus</i>	Spear Thistle	X	X
<i>Cnicus arvensis</i>	Creeping Thistle		X
<i>Erica tetralix</i>	Cross leaved Heath	\	
<i>Calluna vulgaris</i>	Ling, or Common Heather	X	
<i>Vaccinium Myrtillus</i>	Bilberry	X	
<i>Veronica Chamadrys</i>	Speedwell		X
<i>Prunella vulgaris</i>	Self heal		X
<i>Myosotis arvensis</i>	Field Forget me not		X
<i>Rumex acetosa</i>	Sour Dock		X
<i>Urtica dioica</i>	Stinging Nettle		X
<i>Juncus communis</i>	Common Rush	X	X
<i>Juncus articulatus</i>	Spiriet	X	
<i>Juncus squarrosus</i>	Stool Bent	X	
<i>Luzula campestris</i>	Field Woodrush	\	X
<i>Eriophorum vaginatum</i>	Dwarf moss	X	
<i>Anthoxanthum odoratum</i>	Sweet Vernal	X	X
<i>Nardus stricta</i>	Wire Bent	\	\
<i>Agrostis alba</i>	Fiorin	X	X
<i>Holcus lanatus</i>	Yorkshire Fog	X	X
<i>Festuca ovina</i>	Sheep's Fescue	X	X
<i>Festuca duriuscula</i>	Hard Fescue		X
<i>Aira caespitosa</i>	Tussock	X	X
<i>Aira flexuosa</i>	Wavy Hair grass	X	X
<i>Cynosurus cristatus</i>	Crested Dog's Tail	X	X
<i>Molinia caerulea</i>	Flying Bent	X	
<i>Poa trivialis</i>	Rough stalked Meadow Grass		X
<i>Poa annua</i>	Annual Meadow Grass	X	X
<i>Pteris aquilina</i>	Bracken	X	X

Note — As it was found impossible to make a percentage analysis of the herbage on the moor which would be sufficiently accurate, none was attempted of that on the improved enclosure. The text indicates however, the extent to which the plants were found on both areas.

THE REVIVAL OF THE SUSSEX TABLE POULTRY INDUSTRY.

J. W. HURST.

THE Sussex table poultry industry has been centred in and around the two districts of Heathfield and Uckfield, in the Eastern division of the county, since a period long before the construction of the London, Brighton and South Coast Railway, when a service of four-horse wagons regularly carried the fattened fowls to the London market three times a week. During its long history this localised branch of poultry production developed along with it other various minor industries, notably a specialised form of milling oats and the making of appliances peculiar to the exercise of the craft.

In the result, in pre-war days the districts that had in course of time come to depend mainly upon Heathfield and Uckfield stations as the chief centres of departure for the despatch of finished produce owed a good proportion of their prosperity to the flourishing condition of this industry. In a very considerable number of cases whole families found in this work their sole means of earning a livelihood, while a much larger number were enabled to add very materially to an income derived from other sources.

Apart from those engaged in fattening, as a distinct and separate occupation yielding a very satisfactory income of itself, others of those who benefited included a large class of farmers, small holders and cottagers who reared the birds for fattening; the higglers and collectors, employed by the fatteners or working independently; the skilled assistants engaged by the bigger fatteners; and the many cottage women who were enabled to earn from 10s. a week upwards by plucking and stubbing the dead birds on marketing days. Further, in the principal complementary industries many more were regularly employed in the manufacture of the back and other collecting crates, fattening coops, and marketing "pads," as well as in making the machines used in the cramming of the birds.

The development of the distinctive milling process has resulted in the building up of a big industry for the supply of Sussex ground oats, the demand for which has become in recent years very general throughout the whole of Great Britain. Neither must it be forgotten that the present day remarkable, but well deserved, popularity of Sussex fowls among poultry keepers of all

classes has been built up upon the broadly selective work of the breeders, who for many generations had been maintaining a distinctive type of bird especially suited to the requirements of the Sussex table poultry industry.

It is worthy of note, moreover, that the beneficial influences of this localised industry had, before the War, extended not only to other English counties but more especially to Ireland and Wales, whence the fatteners of East Sussex drew considerable and regular supplies of lean live chickens to supplement the large numbers reared in and around the home districts, to enable them to maintain both output and employment.

Such, in brief, was the general condition of affairs in this industry before the War. Some idea of the extent of the operations may be conveyed by reference to a few statistical records.

Statistical Records.—In 1895 the Royal Commission on Agriculture issued a report by an Assistant Commissioner (Mr. (now Sir) R. Henry Rew) on "The Poultry Rearing and Fattening Industry of the Heathfield District of Sussex."* The area dealt with comprised the parishes of Rotherfield, Buxted, Mayfield, Uckfield, Heathfield, Burwash, Brightling, Framfield, Waldron, Dallington, East Hoathley, Warbleton, Chiddingley, Hellingly, and Ashburnham; the trade lying within an easy radius of Heathfield and Uckfield railway stations, from whence the bulk of the produce was (and has been since) sent to London, the former station receiving at that time about five-sixths of the total quantity.

The report states that in the year 1893 the total quantity of dead poultry sent from both stations amounted to 1,840 tons; or, assuming the average weight to have been 4 lb. per bird, a total of more than one million (1,080,400) chickens.

According to information given to the writer by the Railway Company and the local carriers, and recorded in the issue of this *Journal* for March, 1906, the output had at that period increased by some 360 tons; in other words, 200,000 more chickens were being handled per annum than twelve years earlier.

With regard to the inward traffic, in the year 1893 there arrived at Heathfield from Ireland 1,014 "tops" or crates of 50 chickens each, or a total of 50,700 birds; but in the one month of March in 1904, no less than 863 tops were received at that one station. At the latter period (September, 1903 to October, 1904) there were received at Uckfield 18,576 lean chickens from Ireland and 20,304 from Wales.

To come down to more recent times, the following figures which the Railway Company have lately placed at the writer's disposal will enable some estimate to be formed as to the extent to which the trade has been affected as a result of war conditions.

Before and After the War.—The following quantities of dead poultry have been despatched from the principal stations in the fattening districts :—

1913	...	...	...	1,770 tons to London
1919	...	...	...	45½ " , , "

The following quantities of lean live birds have been received at the principal stations in the fattening districts :—

1913	...	...	...	700 tons from Ireland
1919	...	...	...	20 " " "

Although these figures do not include returns from all possible centres of departure and arrival, and so cannot (on account of more modern developments and extensions) be compared accurately with those given earlier in this article, they are sufficiently indicative of the disastrous effects of war-time conditions upon this previously flourishing industry.* During the progress of hostilities not only was the economy of fattening called into question, but the withdrawal of skilled labour and the impossibility of obtaining supplies of suitable feeding stuffs resulted in the general suspension of operations throughout the districts.

The extent of the commencement of the revival as indicated by the 1919 figures has been increased in some measure during 1920, but progress is still very slow. Some of the older fatteners who were forced to close down will probably never make another start. Some of the younger skilled operators will never return, and those who remain are seriously hindered by the high cost of feeding stuffs of the required quality, the increased cost of appliances and of carriage, the inadequate supply of locally reared chickens, the interference with the cross-channel traffic, the rise in wages, and other difficulties only fully appreciated by those who were familiar with the conditions that previously prevailed in this industry.

Food and Freight.—As is perhaps generally well known, the best quality table chickens for which the Sussex producers have been so long noted have been largely reared on Sussex ground oats, and fattened on a mixture of the same meal with fat and milk. Sussex ground oats are a product of the mills of this and

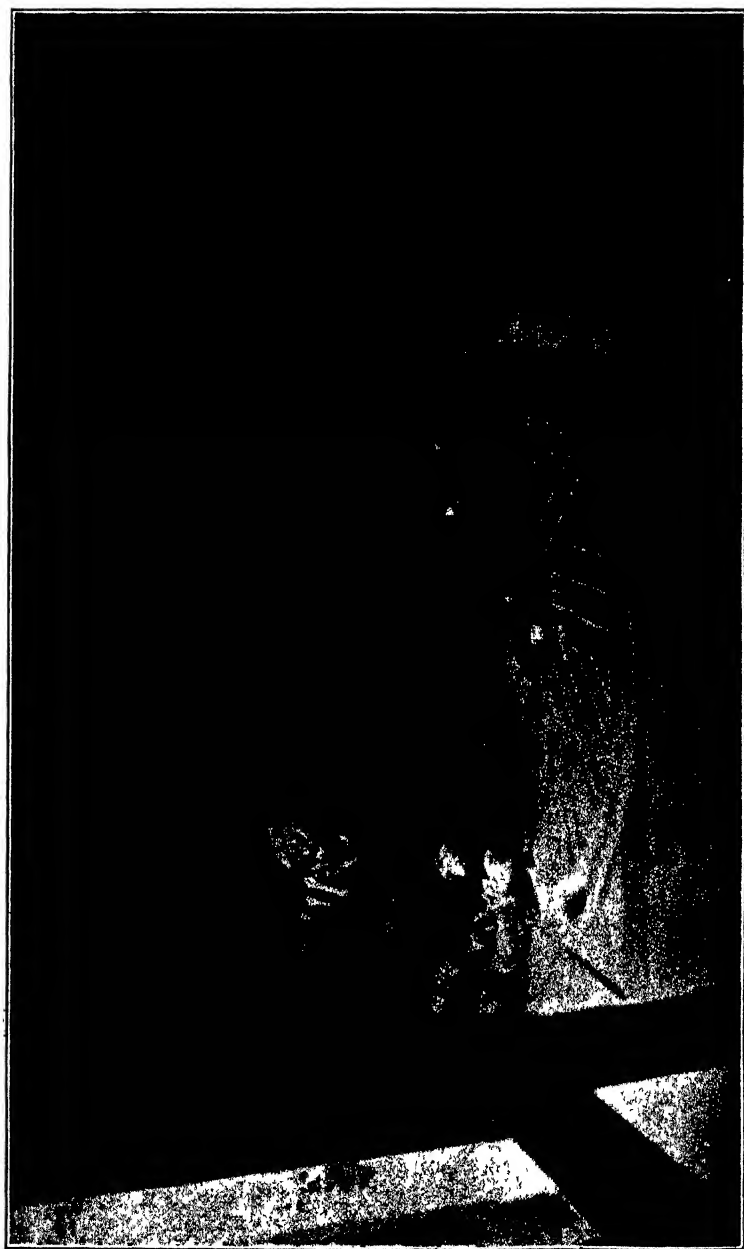
* It is also to be noted that none of the figures quoted include consignments of the finished product to south coast seaside resorts or destinations other than London.



1.—Fattening Coops in the Open (showing the food troughs suspended in front).



2.—Killing day at a Sussex Fatteners (showing plucking and stubbing, and manner of shaping the birds in a press).



3.—The Method of Dressing Mill Stones for the production of Sussex Ground Oats
(showing the furrows and the pitting on the flat sections between)

the neighbouring county of Kent, being stone ground, and the stones specially dressed in accordance with a particular method. This product of the local mills is weighed as 80 lb. per bushel in the Heathfield district and as 82 lb. in the Uckfield district.

The pre-war price of the Sussex ground oats ranged from £8 to £9 or £10 per ton, and the price to-day varies from £26 to £30 per ton according to the quality of oats obtainable and the district to which the meal is to be delivered.

The prices of appliances of all sorts also show a considerable advance, and freight charges are much higher. The following figures have been supplied to the writer by the Railway Company :—

Charges for carriage of dead poultry from the principal stations serving the chicken fattening districts :—

1913	...	...	1/6	per cwt. to London.
1919	...	...	1/7	" "
Sept., 1920	...	...	2/9	" "

Charges for carriage of lean live birds from Ireland to East Sussex :—

1913	...	...	6/10½	per cwt.
Aug., 1920	...	...	8/11	" "
Sept., 1920	...	...	12/6	" "

It will be noted, of course, that in the case of the Irish chickens (when obtainable) the double freight and increase has to be borne by the finished product.

Local Opinions on Prospects.—An extended personal inquiry throughout the districts mainly concerned reveals the existence of some difference of opinion regarding the prospects of progress in the attempted revival of the industry.

A few cases may be mentioned. Of two of the most important firms of millers engaged in the production of Sussex ground oats on an extensive scale, and consequently in a favourable position to gauge the trend of events in this industry, one states that the recent demand from rearers outside the locality (throughout the country generally) has increased considerably, and that within the past few months orders from local fatteners indicate a much more rapid progress than has previously been made since fighting ceased. The other firm, writing in reference to another division of the locality, states that some fatteners have re-commenced on a minor scale, and adds that "it will be several years before anything approaching a pre-war industry will resume, and in future we are of opinion that the industry will be divided among many more people than of yore, and will be treated more as a side line."

A fatterer whose output before the War was among the largest in the trade fears that there is not much prospect of improvement while the cost of production remains at its present level, but that 'under more normal conditions "there is no reason why fattening on a large scale should not work again." He suggests that there is plenty of room for the breeding of birds that will market in good meaty condition without full fattening, and urges the encouragement of "the breeding of good Light or Red Sussex birds to get the stock up in the country"—this in view of the increase of laying stock and the consequent bigger proportion of cockerels that are quite unsuitable for preparation for table purposes.

Again, a local appliance maker who supplies the fatteners reports a recent activity: "many fatteners," he says, "are recommencing in a small way, and they are quite hopeful of another year seeing the fattening industry back a good way towards its former position."

Suggested Possibilities.—As a result of direct personal observation and investigation in the Sussex districts the writer is of opinion that there exists a good workable nucleus of both skilled labour and plant for further development, but that progress is likely to be very gradual. It may, perhaps, be doubted whether there is any possibility of the full recovery of the industry in the more immediate future, in the form in which it existed previously. It is more probable that there will be eventually a somewhat smaller trade of the highly specialized description, so far as concerns full fattening, but that as regards the industry as a whole it should be possible, with a reasonable amount of encouragement, to effect a much more general and widespread extension in a modified form. This should certainly be possible within the county itself, and it is all to the good that at the training centres for ex-service men conducted by the East Sussex Agricultural Education Authority the principles and practice of this branch of poultry keeping are being taught. Such instruction should in any case enable a proportion of the new settlers on the land to participate in the revival of the industry in whatever direction development is found to be most economical, in view of changed conditions and values.

It may be found suitable to encourage the reproduction of this industry in a modified form in other centres, outside the county of its origin, but in this event it would be desirable to commence operations in connection with groups of small

occupiers (working together under some simple form of co-operation) favourably situated as regards the availability of supplies of suitable feeding stuffs, and having easy and relatively cheap access to remunerative markets. Whatever course may be followed, however, the relative economy of the various possible methods of producing table poultry would need to be determined by practical tests undertaken by a competent authority.

Need for Feeding Tests.—Conditions have changed so materially since the War, and values are now so different, that any attempts to encourage the revival or extension of such an industry should be guided by the availability of further and more accurate knowledge respecting the relative economy of the different methods of dealing with chickens for the table intended for market. The methods of rearing generally followed in the industry are:—

1. Killing the birds off the run when in suitable condition.
2. Subjecting them to a period (say three weeks) of special feeding before killing, in the confinement of a small run.
3. Cooping them for ten days or a fortnight and feeding on fattening food mixtures given in troughs.
4. Trough feeding, followed by a further period of machine cramming—the full process of the pre-war Sussex industry.

This test should preferably be carried out in the home of the industry and under the conditions that prevail there, and the breeds or varieties best suited to the different methods should be indicated.*

Until the light of actual accurate experiment, under present-day conditions, is thrown upon this subject in its several aspects, no very satisfactory solution of the problems that confront those previously or now engaged in the industry can be suggested, while the more inexperienced and prospective producers are hopelessly bewildered by the existing lack of reliable information.

* A test on very similar lines has now been arranged by the Agricultural Education Committee of the East Sussex County Council, with the approval and support of the Ministry.

WOMEN'S INSTITUTES AND AGRICULTURAL EDUCATION.*

PERCY G. DALLINGER, O.B.E., B.A.,

*Chief Education Inspector, Ministry of Agriculture
and Fisheries.*

THERE is no means by which co-operation between Women's Institutes and the Ministry of Agriculture can be more effectually secured than by the Officers in each Women's Institute keeping in close touch with the Committee responsible for agricultural education in the county and with the county staff. Where an Agricultural Organiser is appointed, his assistance and advice should be sought on any question connected with agricultural education in the county. If the Women's Institute is satisfied that there is a need for instruction which is not provided, or, if provided, is not within reach of the members of the Institute, this should be brought to the Organiser's notice in the first instance. He may be compelled to say that his staff at that time is unable to undertake additional work, but he is not likely to refuse a reasonable request.

This means can be effectively used not only for securing what is available, but for securing what may be found to be important for further development. If a Women's Institute in a county submitted a considered scheme for the improvement of agricultural education in its district to the Local Authority through the Agricultural Organiser it would very likely receive support. It is suggested that in framing such a scheme the Agricultural Organiser be consulted and that his criticism be invited.

No one who has studied the Women's Institute movement can doubt that it can secure means for its ends, provided that those ends are clearly stated, and that as a preliminary every advantage is taken of the existing machinery. It is true that in some counties the present staff is inadequate; that in all, the staff is busily engaged and it may not be possible to accede immediately to a request for help. Spasmodic requests are the most difficult to meet; a steady demand cannot be ignored.

If Women's Institutes will inform themselves fully of the work of the Agricultural Staff in the County and keep in close touch with the work of agricultural education, they will find that attention will be given to any reasonable proposals they may make for

* Abstract of a lecture delivered to the Women's Institute Section, Forum Club, on Monday, 8th November, 1920.

further help. In this connection attention may be called to the Report of the Sub-Committee appointed to consider the Employment of Women in Agriculture in England and Wales, which was completed at the end of last year.* On page 109 of that Report the Committee makes certain recommendations with regard to the education of women in agriculture. The following may be quoted :—

- (1) That the curriculum of Farm Institutes should provide special domestic-economy classes dealing mainly with labour-saving methods and the use and preservation of home-grown produce ; and that, in those areas where the system of domestic farm servants exists, the Farm Institutes should organise local demonstration classes and simple trials on the above subjects.
- (2) That a number of scholarships for the best of the farm servants themselves should be established at the Farm Institutes for the counties in which farm servants are numerous.
- (3) That all measures for the simplification and acceleration of methods of working in the home and byres should be considered by those responsible for agricultural education and manual training in the local areas.
- (4) That Women's Institutes should develop as fully as possible the experiments they have begun in organising demonstrations in labour-saving methods and in the various branches of household economy ; and that local Education Authorities should give them every facility for classes in connection with these subjects.
- (5) That Women's Institutes should endeavour to extend their organisation as widely as possible amongst wives of farmers and small holders and amongst farm servants.
- (6) That demonstration centres should be established in market-gardening districts in which smallholders are numerous ; and that instruction in all kinds of skilled work in connection with fruit be provided for women.

It would be of great assistance if Women's Institutes would use their influence to secure the carrying out of these recommendations, where no attempt has yet been made to do so.

In the directions indicated above there is considerable scope for very helpful work by Women's Institutes in furthering the interests of agricultural education. There are, however, other directions in which we may work together more closely.

The Ministry is represented on the Executive Committee of the Federation by Dame Meriel Talbot, who is always willing to bring before the Ministry any suggestions which may aid the movement and which it is within the Ministry's province to adopt.

* See this *Journal*, February, 1920, p. 1123.

The Ministry has lately increased the educational Inspectorate and has appointed a woman with high educational qualifications and considerable experience of organisation. It is hoped that this Inspector may be invited to visit Women's Institutes when carrying out her other duties in the county and to consult with the officers. This arrangement would probably prove helpful both to the Women's Institutes, the Local Authority and the Ministry.

The Ministry has during the past few years devoted considerable attention to the preservation of fruit and the drying of vegetables. A special Committee was set up for the purpose of organising experimental work, and temporary premises were acquired for the preliminary operations with the help of a grant from the Development Fund. The results have, in the opinion of the Ministry, justified a continuance of the work under more suitable conditions, and a factory has been acquired at Chipping Campden in Gloucestershire.

The equipment of the factory is now nearing completion, and it will shortly be in full working order. In addition to the experimental work carried on there, provision is made for teaching by a qualified staff. Short courses lasting for a fortnight will be held during the summer and autumn, in which instruction will be given in the best methods of preserving and bottling fruit and vegetables, and a commercial course lasting for three months will also be provided.

Although Women's Institutes can do much to further agricultural education and the work of the Ministry in the directions above indicated, there is something more important still. The War has affected English agriculture no less—probably much more—than other great industries, and future success in any branch of farming will demand a high degree of efficiency in every class of worker engaged in it. To secure this success many things are necessary, but there is none more important, none which is likely to be more fruitful of results, than an earnest belief among young men and women in rural England in the value of knowledge and in the trained capacity to apply it to agriculture.

“Is truth ever barren? Shall we not be able thereby to produce worthy effects, and to endow the life of man with infinite commodities?” If Women's Institutes will direct their influence to encourage the growth of that spirit in the countryside, they will add further distinction to the record of the fine national work they have done already.

A CAMPAIGN FOR INCREASED WHEAT PRODUCTION.

IMPROVED VARIETIES AND MANURES.

A CAMPAIGN, designed to secure, by educational methods, increased production of wheat in this country, has been instituted by the Ministry, and a series of addresses has recently been given in connection with this campaign in certain of the midland counties of England, by the Principal of the Harper-Adams Agricultural College (Mr. P. Hedworth Foulkes).

One of the main objects of the campaign is to increase production, and probably this can best be brought about by raising the average yield per acre throughout the country. To do this is readily possible with the extended growing of the new varieties that give a higher yield.

Proof of the value of practical demonstrations has been provided by the Harper-Adams Agricultural College, Newport, Salop, where the growing of modern improved varieties of wheat has been carried on for many years. One result is that in the course of two or three seasons, several thousand acres in the surrounding counties were employed for cultivating the variety of wheat which had done best in the College Trials. The increased value was then estimated at a figure ranging from 22s. 6d. to £2 per acre.

The average yield per acre for England and Wales from 1867 to 1871 was 27.3 bushels, whereas from 1915 to 1919 the figure was 30.9 bushels. Some of this increase must be attributed to the new and improved yielding varieties which have been grown during the latter period.

For the purpose of comparison the following results of the last three years' Trials at the College are useful. They demonstrate clearly that the average yield per acre for the country could be raised materially by the adoption of one or other of the newer varieties.

<i>Name of Variety.</i>			<i>Yield per Acre in Bushels.</i>			<i>Average.</i>
			<i>1917.</i>	<i>1918.</i>	<i>1919.</i>	
Svalof Iron	...	...	53	61	54	56
Fenman...	...	...	—	54	50	52
Marshal Foch	...	...	—	55	48	51½
Fox	...	...	—	50	52	51
Victor	...	...	48	47	52½	49½
Browick	...	...	46½	55	48	49½
Yeoman	...	...	42	54	47	48
Square Heads Master	...	...	46	45	34	42
Standard	...	...	—	—	33	33

Our old-time boast that the average yield for this country was higher than that of any other country in the world is no longer true, for in 1919 this country fell considerably behind both Denmark and Holland. The following are some significant averages of last year's production :—

Denmark	47·5 bushels per acre
Netherlands ...	37·2
Great Britain ...	29·1
United States	12·5
India	12·6

The new conditions are likely to offer extended scope for the use of manures. Even at present prices an increased yield of 8 bushels repays amply the application of 1 cwt. of sulphate of ammonia.

Judicious manuring is one of the surest aids to increased output, and the result of experiments on the time of application should prove of value to those who are prepared to depart from the older customs of limiting themselves to the employment of farmyard manure on the clover root.

As the result of three years' experiences with the sulphate of ammonia, applied in the College Trials at fixed times of the year, it has been shown that though this fertiliser increased the yield when applied in the autumn, the maximum increase—8 bushels per acre—was obtained by an application at the end of February or in early March.

The danger of over-manuring need not be a deterrent, as there are varieties of wheat available which are strong enough in the straw to carry the resulting large head and big berry. Such varieties as Svalof Iron and Yeoman are very different in this regard from the older Standard Red.

The time of sowing raises an important question. There is the choice of two seasons—autumn or spring, but all available results of experiment bear out the contention that the early sown grain does better. In the College Trials in 1917/1918 the yields were :—

<i>Time of Sowing.</i>	<i>Yield per Acre.</i>	
	<i>Corn.</i> bush.	<i>Straw.</i> cwt.
30th September	34	43
13th October	30	39
6th November	20	36
20th November	Crop a failure.	

Considering the present price of seed, much remains to be done in checking the present annual waste. The reduction of a half to three-quarter bushel of seed per acre over the country would mean a saving of £1,000,000 per annum.

The value of moderate seeding was demonstrated in a series of Trials at Newport in 1918 and 1914, when the following results were obtained :—

<i>Rate of Sowing.</i>	<i>Yield, 1918.</i>		<i>Yield, 1914.</i>	
	<i>Grain.</i> bush.	<i>Straw.</i> cwt.	<i>Grain.</i> bush.	cwt.
2 bushels per acre ...	45	41	47	47
2½ " " " ...	43	40	47	45
2½ " " " ...	46	42	47	49
2¾ " " " ...	46	48	42	48
3 " " " ...	38	47	35	43

(Sown 15th and 17th October. Variety, Browick).

There are many other points worthy of the consideration of the wheat grower, for the crop is in most parts not only a safer one to grow than oats, but it will also compare well with barley. In the Midlands oats are becoming increasingly difficult to grow owing to the repeated attacks of the Frit Fly.

THE DISTRIBUTION OF WART DISEASE.*

H. V. TAYLOR, M.B.E., A.R.C.Sc., B.Sc.,

*Deputy Controller of Horticulture, Ministry of Agriculture
and Fisheries.*

In the first and second parts of this article, published in the November and December issues of this JOURNAL, an account was given of the possible origin of Wart Disease in this country, the earliest traces of the disease in this country, its spread in recent years and influence on the varieties grown, and the incidence of transport and distribution on the spread of the disease.

Control of the Disease, and Immune Varieties.—When the economic importance of Wart Disease became apparent in 1907, it was necessary to establish trials of potatoes for the purpose of investigating the disease, the manner in which potatoes were attacked, and to discover, if possible, measures of control. Much success has already been achieved, but the trials generally have shown an amazing ignorance of the whole matter, especially of the subjects of soil sterilisation, and the accurate life history of the organism.

When the life history of the disease was being investigated, it was established that the fungus was in the nature of a soil organism, and it became necessary to discover means whereby the spores of the fungus could be killed, and the soil sterilised and made suitable once more for the production of clean crops.

Malthouse, Snell, and others have attempted such research, but their investigations have met with no measure of success. In another direction fruitful results have followed from Mr. Gough's investigation of the disease for the Ministry in Cheshire, when clean crops of Snowdrop, Conquest, and other varieties growing in infected soil, were noted; in the following year he stated that Snowdrop, Conquest, Golden Wonder, and Langworthy were immune, or practically so.

About this time the disease, which was causing considerable damage to the farm crops in Lancashire, Cheshire, &c., aroused alarm amongst all potato growers. It was apparent

* Report of a paper read before the British Association for the Advancement of Science, at Cardiff, on 24th August, 1920.

that there was need for experimental work to find some means of helping the farmer to combat this newly-added difficulty.

In 1909 the Ministry (then the Board) of Agriculture asked the Lancashire County Council, the Harper Adams Agricultural College, and the Holmes Chapel Agricultural College to arrange a series of trials of potatoes on infected land in their counties.

Three sets of trials were arranged by the Lancashire County Council, and one each by the two Colleges. In Lancashire two of the trials were on infected fields, viz., one near Ormskirk, and one near Manchester, while the third trial was carried out in the grounds of the Ormskirk Workhouse, which even then were badly infected. In Shropshire a number of adjoining infected gardens were selected, and in Cheshire one badly infected field.

All the trials were instituted by the Ministry of Agriculture, and were consequently carried out on similar lines. Their purpose was to obtain information in two directions :—

- (a) The possibility of a remedy by sterilizing infected soil.
- (b) The immunity of different kinds of potatoes.

Negative results were obtained under (a), but the trials under (b) showed that of the commoner varieties of potatoes then cultivated the majority were susceptible, but that a few, viz., Langworthy, Golden Wonder, Abundance, Conquest and Snowdrop, remained clean, even though grown in infected soil.

In the following year, the immunity experiments were enlarged, so as to include other varieties not previously tested. The results obtained showed that those kinds previously tested (in 1909) had remained immune, and in addition Aberlady Early, Favourite, Supreme, Crofter, Laird, Provost, and White City were not infected.

This establishment of the immunity of certain varieties of potato from Wart Disease was of the greatest importance to the potato-growing industry, and to the Ministry of Agriculture in its attempt to control the disease.

The county trials, having served a useful purpose, were discontinued, but Mr. Malthouse, of Harper Adams College, assisted by Sir Beville Stanier and by a grant from the Ministry, instituted further trials between 1911 and 1914.

The result of these trials was that the list of immune varieties was extended by the addition in 1911 of the following varieties :—

Crimson Kidney, Early Favourite, Empire, Goodfellow, Invincible, Monarch, New Provider, Redskin Flourball, Snowball, Stourbridge Glory, Wordley Pride, Improved Kidney, The Admiral, Leinster Wonder (an Irish potato), and five French varieties.

As a result of the trials in 1912 and 1913, the following twenty-seven varieties were also proved immune :—

Early.—Peerless Rose, Field Ashleaf, A.1, Gelly's Early, Juni, and North Pole.

Second Early.—King George V, Entente Cordiale, Seedling B4, Weltwunder, Table King, and Adirondack.

Main Crop.—The Lochar, Great Scot, Culdees Castle, Irish Queen, St. Malo Kidney, Dalmeny Sun, Flourball, Variety unnamed (Ministry of Agriculture), Alice, Callico, Unique, General Kuroki, Brocken, General Nodzu, and Borderer.

There were thus after 1913 about fifty-three varieties of potatoes of importance known to be immune.

The Ormskirk Trials.—By 1914 the disease, which had greatly increased in the South Lancashire area, was so destructive to the potato crop in the fields, that the late Mr. John Snell, then Inspector for the Ministry of Agriculture in charge of the Northern district, commenced trials in what may be termed the great potato-growing area of the North of England.

With the support of the Lancashire farmers and a few of the Scotch seed potato growers, Mr. John Snell in 1915 commenced trials on the land kindly lent for the purpose by the Guardians of the Poor Law Institution. The course pursued was :—

1. To test all the varieties of potatoes in commerce in this country in order to discover which were immune from Wart Disease.
2. To demonstrate the disastrous results of planting non-immune varieties on land infected with Wart Disease.
3. To record accurate characteristics of individual varieties.
4. To classify varieties to types.
5. To discourage the use of synonyms.
6. To encourage the raising of new varieties.
7. To discover a means of sterilising infected soil.

Number of Varieties tested.—It was seldom that any potatoes were purchased for planting in the trials. All persons were invited to send seed of any kind, and the way in which the trade generally took advantage of this invitation is shown by the following figures :—

1915	there were	94	varieties tested.
1916	" "	159	" "
1917	" "	140	" "
1918	" "	301	" "
1919	" "	472	varieties and 839 seedlings.

The report of each year's trials separated varieties into three groups, viz. (1) Immune Varieties; (2) Non-immune Varieties; and (3) Varieties of doubtful Immunity.

In the first group were placed all varieties on which no Wart Disease had been seen, and in the second were placed all those potatoes found to be affected with Wart Disease in varying degrees of intensity. Where Wart Disease was found on the haulm or tuber, or both, of one or two plants, and it was not possible to determine that the affected plants were "rogues," the varieties were, for the time being, regarded as of doubtful immunity. The tubers from the doubtful plants were destroyed, and those from disease-free plants were saved and tested in the following season; e.g., in 1915, Ally and Edzell Blue were both classed as of doubtful immunity. After selection and on retesting in 1916 both proved to be immune, showing that the plants affected with disease in 1915 were "rogues," i.e., plants of some other variety.

As a result of Mr. Snell's work in testing the large number of varieties and seedlings dealt with, the list of varieties proved to be immune from the disease was raised from 55 in 1914 to 130 in 1919.

Susceptible Varieties and Infected Land.—In order to demonstrate to the many potato growers visiting the trials the futility of planting susceptible varieties in infected land, Mr. Snell planted plots of susceptible varieties in some of the infected land. Generally, Cumberland Ideal, Arran Chief, President, Up-to-Date, King Edward, and British Queen were used. On clean land these are heavy croppers, but on infected land the crops were greatly reduced; e.g., in 1918, three plots were planted with Cumberland Ideal, with the following result:—

No.	Clean Tubers per Acre.			Worted Tubers per Acre.			Total Crop per Acre.	
	Tons.	Cwt.		Tons.	Cwt.		Tons.	Cwt.
1	1	11	.....	3	18	.....	5	9
2	1	7	.....	3	15	.....	5	2
3	1	13	.....	3	11	.....	5	4

The average crop of clean tubers was only 30 cwt. to the acre, whereas that of Great Scot or Ally in the same year at the trials gave average crops, respectively, of 13 tons 17 cwt. and 18 tons 12 cwt. per acre.

On clean land neither of these varieties would prove superior croppers to the susceptible kinds. The great loss of crop which must be attributed to the ravages of Wart Disease is a serious matter to the farmer.

Conditions influencing Intensity of Disease.—For several years there has been a general belief that the intensity of the disease was greatly increased during periods of excessive rainfall, but until 1919 no actual figures were available to confirm this belief. Previously, many of the highly susceptible varieties produced crops of warted tubers far in excess of the clean crop, but in 1919 the intensity of the disease was so slight that in all cases the reverse held good. In view of the fact that there was no rain in 1919 from mid-April until the 29th June, and, in fact, very little during the summer, it appears highly probable that the *lack of moisture* was the essential factor lessening the *intensity* of attack.

The following figures taken from Mr. Snell's report illustrate this point:—

<i>Variety.</i>	<i>Clean Tubers.</i>		<i>Warted Tubers.</i>	
	<i>Tons.</i>	<i>Cwt.</i>	<i>Tons.</i>	<i>Cwt.</i>
1918 Cumberland Ideal ...	1	11	.....	3 18
1919 " " ...	1	13	.....	— 19
1918 Arran Chief ...	2	5	... ..	5 12
1919 " " ...	5	—	.....	— 15
1917 General ...	4	15	.....	4 19
1919 " 	3	5	.....	4 11

Where a variety usually gave a greater proportion of clean tubers than warted, the weight of the latter was much less than in previous years.

<i>Year.</i>	<i>Variety.</i>	<i>Clean Tubers.</i>		<i>Warted Tubers.</i>	
		<i>Tons.</i>	<i>Cwt.</i>	<i>Tons.</i>	<i>Cwt.</i>
1918	Epicure	6	15	.....	1 12
1919	"	3	17	.....	— 3
1919	"	3	16	.....	— 1

A point of considerable scientific interest, and one which Mr. Snell had hoped to investigate, is that the proportion of clean to warted tubers varies considerably with the variety. This conclusion has been arrived at after four years' work, and in 1919 it was hoped to travel further along this line of investigation, but the dry season rendered all observations almost worthless. In order to illustrate the point, a table of figures obtained in 1918, of varieties of certain types, with the weights of clean and warted tubers is given:—

Variety.	Clean Tubers per Acre.			Warted Tubers per Acre.	
	Tons.	Cwt.		Tons.	Cwt.
Cumberland Ideal	...	1	11	.....	3 18
" "	...	1	7	.....	3 15
" "	...	1	13	.....	3 11
Proportion	...	1 clean		.....	2·5 warted.
<i>President type—</i>					
President	...	5	10	. ...	3 6
Scottish Farmer	...	5	11	.....	3 1
Iron Duke	...	4	12	.....	3 11
Proportion	...	1 clean		.....	·66 warted.
<i>Up to-Date type—</i>					
Prosperity (No. 1)	...	8	3	.....	5 10
Rentpayer	...	7	6	.....	4 18
Proportion	...	1 clean		.....	·7 warted.
<i>Arran Chief type—</i>					
Arran Chief	...	2	5	.....	5 12
Prosperity (No 2)	...	3	9	.....	5 4
Proportion	...	1 clean		.....	2·7 warted.

Recording of Characteristics of Potatoes.—Every variety sent in to be tested was carefully studied throughout the season, and the following facts were noted:—the colour of the haulm, the presence or absence of bronzing and of wings on the haulm, the type of wing, the colour of the leaves and flower, the colour and shape of the anthers, the presence or absence of pollen, the approximate proportion of fertile to sterile pollen grains, the shape of the tubers, the shape, depth, position and number of eyes, the colour and texture of flesh, the colour of sprout at time of planting, keeping and cooking qualities, resistance to blight, and degree of susceptibility to Wart Disease. A few illustrations will show the practical value of this work. Let us take the two varieties Arran Chief and Great Scot, which appear to cause considerable confusion, and about which it is important that growers and merchants should be very clear, as Arran Chief is very susceptible to Wart Disease.

(1) Arran Chief has an upright habit, the upper leaves are erect and slightly mottled, the foliage is medium green; the haulm is bronzed and the wings are goffered; the flower is white, and the calyx has a band of yellowish green round it. The tubers are somewhat difficult to distinguish from Great Scot, but at time of planting the sprouts are dark purple.

(2) Great Scot has also an upright habit, but the leaves are inclined to be repand, they are dark green in colour and have no mottling; the haulm is also bronzed, but the wings are knife-edged; the flower is white, but it is not such a free flowering variety as Arran Chief; the calyx is bronzed, and does not possess the band of lighter colour; the sprouts are pale pink at the time of planting.

There is need from many standpoints for the careful recording of detailed characteristics of all plants, and especially so for a plant of the economic importance of the potato.

Practical growers, breeders, raisers and research workers may, in the past, have lacked help in not possessing some standard work of reference to guide them as to the trueness of varieties. In the five years during which Mr. John Snell worked, he dealt with, and made careful records of, some 500 varieties, and his work will be appreciated by, and be of use to, many. This work is of particular value to potato breeders, for varieties giving fertile pollen are essential to them.

This part of the work is still in its infancy, but some useful information has been obtained. It has been shown that certain varieties, such as Ally and Up-to-Date, have no fertile pollen, and in the case of Ally, malformed anthers is an accompanying factor. Such varieties would be useless as male parents for crossing. A knowledge of these facts is useful in analysing stated pedigrees of new varieties or seedlings. In 1918, two seedlings were sent to Ormskirk to be tested. The parents of one were said to be Up-to-Date and Duchess of Cornwall, of the other, Up-to-Date and Factor. Duchess of Cornwall and Factor are synonymous with Up-to-Date. At Ormskirk no Up-to-Date has been grown which produces fertile pollen.

Types and Synonyms.—After carefully recording detailed characteristics of such a large number of varieties, most workers on plants would naturally be struck by the remarkable similarity of certain kinds, which in some cases was so close as to suggest synonymous varieties. Mr. Snell has classified the different varieties into types or groups, and has examined the reasons why in some cases two or more names have been given to the same variety. Among the causes are :—

(1) Old varieties have been renamed for trade purposes.

(2) New names have been given to selections from older varieties, as, for example, where a stock of Up-to-Date has shown signs of deterioration. The grower has perhaps sent a supply of the variety to Scotland to be grown there for

several years, and, when it has been regenerated, has put it on the market under another name. That this must have been done very frequently is obvious, as the number of varieties assigned to the Up-to-Date type is up to the present well over twenty.

(3) Occasionally, promising "rogues" are noted and selected from a field of another variety. These may have been propagated, named, and placed on the market.

(4) Synonymous varieties occasionally arise through a stock of a new seedling coming on to the market through two distinct channels. A very good example of this is Tinwald Perfection and Rob Roy. These varieties are identical, but the latter was part of a stock of Tinwald which had been overlooked by the raiser and was sold to Mr. McAlister, who placed it on the market under the name of Rob Roy, not knowing that it was already there as Tinwald Perfection.

(5) Seedlings may arise which are identical in every respect with older varieties or with other seedlings, and there is positive proof of this, *e.g.*, Mr. McKelvie, of Arran Comrade fame, had, among a batch of seedlings, one identical with Up-to-Date. Mr. Cuthbertson has had from seedballs of Myatt's Ashleaf, seedlings identical with Snowdrop and Duke of York. Mr. Malthouse sent a seedling to Ormskirk last year which he called "Salopian," which is identical with broad-leaved Ashleaf. Although seedlings similar to older varieties do arise, we do not know with what frequency.

That there was a great deal of unreliable information connected with this subject, Snell was well aware. Unnamed seedlings have been sent to Ormskirk to be tested; these were assigned to the Arran Chief type. Yet the parents of one were said to be British Queen and Abundance, and the parents of the other were not known; it was a seedling from a chance "seedball of President." It does not seem possible that two seedlings botanically identical with each other and with Arran Chief could have been produced from parents so widely divergent in character.

Again, seedlings identical with Up-to-Date have been produced by crossing British Queen with Kerr's Pink, and Up-to-Date with Factor, and yet it is known that the last-named produces no fertile pollen. Up to the end of the 1919 trials, Mr. Snell had noted 88 types, the most important of which are British Queens, King Edward, Up-to-Date, Abundance and Sharpe's Express types. It is interesting to note that the newer immune types contain very few varieties.

(Concluded.)

THE INSPECTION OF POTATO CROPS DURING 1920.

MEASURES FOR THE CONTROL OF DISEASE IN POTATOES.

It need hardly be stated that considerable improvement may be effected in the quality of future crops if care is taken in the preparation and production of seed. This is very evident in the case of the potato, which in England is grown chiefly for consumption and only secondarily for "seed" purposes. For consumption purposes it matters little if a small proportion of the plants ("rogues") are of a different variety from the bulk, but if a crop is grown for "seed," the presence of "rogues" may be of serious consequence. This is especially the case with crops of immune varieties, where the presence of "rogues" susceptible to Wart Disease may mean a lessened crop and lead to a great increase of this dangerous pest. In order to remove the risk as far as possible, the Ministry, in connection with its policy of only allowing the entry of immune varieties of potatoes into Infected Areas, has established a system of crop inspection by which certificates may be obtained by growers, free of cost, if after examination their crops are found true to type and free from "rogues." At present only certified immune "seed" potatoes are allowed entry into the Infected Areas, and to comply with this regulation both the Board of Agriculture for Scotland and the Department of Agriculture and Technical Instruction for Ireland have undertaken the inspection of crops and the issue of certificates in their respective countries.

In England the inspection is carried out by the Inspectors of the Horticulture Division, who are experienced in the identification of the different varieties of potatoes. The inspection in England this year began early in July, and continued until about the end of September, when the haulms were still recognisable.

Last year some 650 applications for the inspection of approximately 6,500 acres were received, but this acreage was greatly increased during the present season, no less than 11,664 acres being inspected in England alone. The number of applications for inspection was 1,221. Of the whole area inspected 10,592 acres were certified and 1,132 acres were rejected for various reasons. As was to be expected, the bulk of the applications for inspection were received from the northern counties, princi-

pally Lancashire, Lincolnshire and Yorkshire, but a considerable acreage in Cambridgeshire, Cheshire, Cumberland, Shropshire and Staffordshire was inspected. The following table gives the figures for the chief potato growing counties. They relate only to the northern and midland counties, as farmers in the south rarely grow potatoes for "seed," and hence do not apply for inspection of their crops. The rarer varieties are not included in this return.

County.	Acreage.	
	Passed.	Rejected.
Cambridge	278	29
Cheshire	215	2
Cumberland	858	37
Lancashire	3,526	453
Lincolnshire	1,423	72
Shropshire	1,090	171
Staffordshire	947	225
Yorkshire	610	48

The most popular variety was "Great Scot," of which nearly 3,000 acres were certified, and approximately one-tenth of the crops grown rejected. This was more than twice the acreage of Ally, which was the next popular variety. Some 1,294 acres of this variety were passed, but one-quarter of the acreage inspected (438 acres) was rejected owing to the great prevalence of "rogues." Most of the rejected crops had been produced from Scottish seed certified in Scotland the previous season.

When Ally was introduced to the potato industry it possessed great cropping capacity, and now that the quality and many other favourable characteristics have improved, it is likely to be increasingly grown for seed, if growers take sufficient care to raise and maintain pure stocks. The varieties Majestic, King George and Kerr's Pink were next in importance, the acreage inspected being 1,384, 1,382, and 1,284 acres respectively.

The total acreage in respect of the chief varieties for England and Wales grown during 1920 was as follows:—

	Acreage inspected.	
	Passed.	Rejected.
Ally	1,294	438
Arran Comrade	522	7½
Dargill Early	135	2½
Edzell Blue	120½	½
Golden Wonder	51	5½
Great Scot	3,004	292
Kerr's Pink	1,254½	30½
King George	1,233½	149
Lochar	548½	32½
Majestic	1,271½	113½
Templar	498	39
Tinwald Perfection	351½	10½
Witch Hill	33	½

Up to the present the chief concern of the Inspectors has been to see that "rogues" were absent, or, if present, were removed before the crop is certified. Little more has been done except to note the presence of diseases, but in the case of inheritable diseases such as Leaf Curl, if the disease was present to any extent, the Inspector has persuaded the grower to dispose of the crop for ware purposes, and not to sell for seed. Very few crops have been rejected on account of disease alone.

Diseases.—Blight.—Blight was the most prominent disease found on inspected crops. It started early in some parts of Lincolnshire, making proper inspection rather difficult, and it was necessary for the Inspectors to concentrate on this area so as to finish their work before the haulms had been destroyed. Elsewhere, although present, the blight did not spread to the same extent, and the Inspectors were able to finish their work before the haulms had died down.

Leaf Curl.—This disease is responsible for very seriously lowering the potato yield in many parts of the country, and as it is perpetuated from season to season by means of the "seed" it is extremely important to eliminate it as far as possible from crops intended for "seed" and from the "seed" growing areas. Leaf Curl has been much investigated of late and it has been proved to be not only inheritable, but infectious (see Leaflet No. 164). It is common all over England, but its attacks are more severe in the south. During the inspection some bad cases were noted, and, as already mentioned, the grower was persuaded to use his crop for ware purposes. In other cases, where it was less abundant, a selection from the best parts of the field was advocated. In certain areas cases were noted in which curling of the foliage occurred which was not referable to true Leaf Curl. The most striking were those where fields had been partially or entirely flooded in spring, the plants on the flooded areas showing a curling of the foliage which was absent on the partially flooded areas.

Mosaic.—The mottling due to Mosaic is seen very generally and clearly in the varieties Golden Wonder, Langworthy, Burnhouse Beauty and Tinwald Perfection, especially early in the season and in the cooler districts. It is also known in many other varieties, but to a lesser extent. Mosaic disease, which is known to reduce the yield very seriously in many counties, is receiving close attention by the Ministry's experts.

Blackleg.—This disease has been noted in most districts, but usually only in a small quantity. In most instances the plants affected had probably died down before the land was visited. No variety seems to be immune.

“ Rogues.”—“ Rogues,” i.e., potatoes of a variety foreign to that planted, may be due to either self sets, *e.g.*, plants which have been produced from tubers left from previous crops, or from tubers introduced with the seed. Owing probably to mild winters, the self sets have been rather more prominent, especially on land where potatoes come frequently in the rotation. The following are the common “ rogues ” in the chief varieties:—

<i>Variety.</i>			<i>Chief Rogues.</i>
Edzell Blue	...	...	Lord Tennyson, Rule Britannia, Forty Fold (Immune).
Arran Comrade	...	...	Generally very free. Ally “rogue” found.
Ally	...	...	Arran Beauty (a British Queen), Up-to-Date, President, and a pink-eyed round, probably, Marquis of Bute.
Great Scot	...	...	Arran Chief, British Queen, Abundance, Templar Lochar and Date, President.
Keir’s Pink	...	...	King Edward: usually very free from “rogues.”
Tinwald Perfection	...	...	Up-to-Date.
Lochar	...	...	Usually very free. British Queen and Up-to-Date found.
Majestic	...	...	British Queen and K. of K. most frequently met; also cases where King Edward has appeared. King Edward and Great Scot.
Bishop	...	...	Up to-Date.
Templar	...	...	Usually very pure: occasionally a “Date” rogue
Arran Victory	...	...	Occasionally an Edzell Blue.
King George	...	...	Rogues very variable. British Queen, Ally, Date President, Eclipse, Lothair, and Great Scot.
Langworthy type	...	...	Usually Up-to-Date.
Abundance type	...	...	British Queen, King George and Ally.

The list of growers whose stocks of potatoes have been certified as true to the variety stated and of the recognised standard of purity is now ready. Copies may be obtained from the Offices of the Ministry, 3, St. James’s Square, London, S.W.1, price 2s. post free.

POTATO GROWING.

Potato Demonstration Plots, 1921.—In view of the importance of the potato crop on both farms and allotment gardens, it is desirable that potato growers should be able to obtain adequate and reliable information on all matters relating to potato culture, many phases of which may best be brought to their notice through the medium of demonstration plots. Further, the spread of Wart Disease throughout the country, and its effects on the potato crop, render it important that the qualities of the most promising of the varieties which are immune from this disease should be demonstrated to growers. The Ministry, therefore, suggests that potato demonstration plots should be set up throughout the country in 1921 for the purpose of ascertaining those immune varieties best suited to different districts, and also to demonstrate the approved methods of potato culture. County authorities responsible for horticultural education have accordingly been asked to institute demonstration plots in the different districts within their area on the lines stated below.

Varieties.—It is proposed that the trials in 1921 should be divided into two main sections:—(1) trials of first early varieties, and (2) trials of second early and main crop varieties. The second early and main crop varieties chosen for demonstration are:—Ally, Arran Comrade, Early Market, Great Scot, King George, Kerr's Pink, Lochar, Majestic and Tinwald Perfection.

Supply of Seed.—It has been decided for various reasons that it would be advisable to obtain all the seed used in these demonstrations from the same source, and the Ministry has accordingly made arrangements with a Scottish seed potato merchant to reserve a quantity of seed potatoes of the trial varieties for planting in the demonstration plots in 1921.

Quantity of Seed.—28 lb. of each of the above varieties will be planted on land which has been prepared according to the instructions given below.

Manures.—The land should receive a dressing of farmyard manure at the rate of 15-20 tons per acre, applied in the drills at the time of planting. Artificial manures should also be applied, on dates to be recorded, in quantities somewhat as follows:—

Superphosphate (26 per cent.)	-	-	4½ cwt. per acre
Sulphate of Ammonia	-	-	1 cwt. per acre
Sulphate of Potash	-	-	1 cwt. per acre

These suggestions may require modification according to local customs and conditions.

Planting.—The time of planting will vary slightly according to the district. It is also suggested that a distance of 30 in. between the drills, and 12 in. between the sets, should be maintained throughout all the trials.

Imported Seed Potatoes from Scotland.—The Ministry of Agriculture and Fisheries has recently issued an Order, under the title “Wart Disease of Potatoes (Imported Scottish Seed Potatoes) Order of 1920,” which is of importance to all potato growers and merchants who obtain seed potatoes direct from Scotland.

The main provision of the Order is that any importer who receives from Scotland “seed” potatoes which are not accompanied by the necessary declaration (as set out below) shall report the fact to the Ministry within seven days of the receipt of the potatoes.

The declaration required is:—

- (1) In every case of a consignment of any seed potatoes, other than certified stocks of immune varieties, a declaration correctly stating the reference number of the certificate issued by the Board of Agriculture for Scotland to the effect that wart disease has not existed on, nor within one mile of the place in which the potatoes were grown.
- (2) In the case of certified stocks of approved immune varieties, a declaration stating correctly the serial number of the certificate of purity issued in respect of the growing crop.

MANURES IN JANUARY.

E. J. RUSSELL, D.Sc., F.R.S.,

Rothamsted Experimental Station, Harpenden.

The Proper Time for Top Dressings.—Many inquiries are made as to the proper time for applying top dressings to farm crops. The general rules are as follows:—

GRASS LAND.—*Any time in autumn or winter:* lime, chalk, basic slag, kainit (on hay land).

Spring: superphosphate, sulphate of ammonia, nitrate of soda, nitrate of lime, nitrolim (the latter four on hay land).

ARABLE LAND.—*Winter corn, at time of sowing seed:* superphosphate, basic slag, kainit, sulphate of potash, muriate of potash.

Spring: sulphate of ammonia, nitrolim, as early top dressings; nitrate of soda, nitrate of lime, as later top dressings.

ROOTS.—*Autumn: on stubble of preceding crop:* lime or chalk; farmyard manure in eastern and southern parts of the country.

Spring, at time of sowing seed: superphosphate, kainit, sulphate of potash, muriate of potash, sulphate of ammonia, nitrolim; and on mangolds, salt.

Time of singling: nitrate of soda, nitrate of lime, salt (to mangolds).

In the case of swedes it is often not advantageous to give large dressings of artificials in addition to dung: mangolds, however, can take considerable quantities.

SEEDS LEY.—*Autumn:* lime, chalk, basic slag.—*Spring:* liquid manure if available; nitrate of soda or sulphate of ammonia if necessary to encourage grass on mixed leys where clovers are failing.

What Crops are Benefited by Chalking or Liming?—

Assuming that lime or chalk is available, what will be the best way of applying it? If the land is thoroughly sour all crops benefit. If it has not been allowed to get into such condition, and is only beginning to suffer from lime shortage, then the crop that derives most benefit is clover; swedes and barley also benefit; wheat and oats derive no benefit except in bad cases. After an improved clover crop, however, the subsequent cereal crops usually benefit, while there is often the additional advantage in the ease of working the land and a reduction in costs, matters which are of importance to the farmer.

Some of the results obtained at Rothamsted are:—

				<i>Land chalked in 1913.</i>			
				<i>Chalked.</i>		<i>Unchalked.</i>	
				<i>26 loads fine.</i>	<i>50 loads lump.</i>		
1914.	Oats, grain	... bush.		37·3	41·1	—	44·6
1915.	Clover, hay	cwt.		35·8	39·2	20·2	18·6
1916.	Wheat, grain	bush.		33·8	30·2	24·2	31·3
	straw	cwt.		40·3	35·0	30·5	35·5
1917.	Oats, grain	bush.		29·7	27·1	23·6	28·3
	straw	cwt.		22·8	22·9	23·2	23·6

The variations on the unchalked plots are characteristic of land beginning to show signs of sourness.

Comparison of Organic and Ordinary Artificial Manures.—

Reference has several times been made in these notes to the fact that organic manures are not worth a specially high price to the ordinary arable farmer, although they may have particular value to the gardener and the market gardener because of their convenience in handling and the fact that they are fool proof.

A similar conclusion is arrived at by Dr. J. G. Lipman and A. W. Blair, of the New Jersey Experimental Station, whose results are so important that they deserve full consideration. The results are as follows, worked out on the basis of 1/20-acre plot:—

Plot.	Dressing.	Increase over Control for 5 years, 1913-17.			
		Unlimed.		Limed.	
		Total Grain	Hay, Straw, Stalks, &c.	Total Grain.	Hay, Straw, Stalks, &c.
9	Nitrate of soda	1,917	7,622	1,097	4,710
10	Nitrate of lime	1,262	7,107	2,057	6,955
11	Sulphate of ammonia ..	1,232	3,367	2,192	7,020
12	Nitrolim	1,522	4,532	1,667	4,875
13	Dried blood	1,157	4,637	1,747	4,505
14	Fish	1,557	5,847	1,572	3,660
15	Tankage	1,242	3,777	1,492	3,275
5	Cow manure	2,592	10,332	1,237	5,505
6	Horse manure	2,662	11,837	1,332	5,875
8	Nitrate of soda (half dressing)	547	2,667	1,322	2,440

The quantities of the various fertilisers on Plots 9-15 contained the same amount of nitrogen, equal to 320 lb. nitrate of soda per acre. Horse and cow manure were supplied at heavier rates, viz., 32,000 lb., or nearly 15 tons, per acre.

Taking the average of the organic manures and of the artificials the results work out as follows:—

	Average Yield of Dry Matter.				Percentage Nitrogen recovered.			
	Unlimed.		Limed.		Unlimed.		Limed.	
	1908-12	1913-17	1908-12	1913-17	1908-12	1913-17	1908-12	1913-17
	lb.	lb.	lb.	lb.	Per cent.	Per cent.	Per cent.	Per cent.
Average of 4 artificials—								
Grain	6,002	3,631	6,390	4,311	40.1	29.4	49	33.3
Straw, &c.	14,486	11,715	15,655	12,380				
Average of 3 organic materials—								
Grain	5,608	2,467	6,075	4,002	27.3	24	29	27.1
Straw, &c.	12,508	10,812	12,597	11,262				

A similar long series of experiments carried out at Ohio under Director C. E. Thorne has been summarised. The results for the 16 years 1903-18 are as follows:—

Crop.		Nitrate of Soda.	Sulphate of Ammonia.	Tankage.	Nitrate of Potash.
		Plot 8.	Unlimed Land.	Plot 18.	Plot 22.
Tobacco	(lb.)	1,227	1,095	960	1,131
Wheat	(bush.)	26.63	25.82	26.16	25.15
Clover	(lb.)	4,416	4,149	4,360	3,987
Annual Values*		\$93.82	\$85.79	\$79.97	\$86.61

		Limed Land.		
		Plot 26.	Plot 28.	Plot 29.
Tobacco	(lb.)	1,069	1,082	959
Wheat	(bush.)	27.78	28.05	23.96
Clover	(lb.)	4,139	4,193	2,054
Annual Values		\$85.77	\$86.78	\$77.44

Again, nitrate of soda proves superior on the unlimed land, but the superiority disappears when the land is limed. Artificial manures prove more effective than the organic manures.

Manuring in Glass Houses.—It is not the purpose of this section to deal with glass houses, but two important principles brought out may be mentioned. Nitrogenous manures encourage development of the leaf and stem, but not always of the fruit. At the Experimental Station at Cheshunt it was found that there was more fruit when nitrogen fertilisers were omitted than when they were supplied. The soil in this case is not far removed from a virgin loam and is still rich in nitrogen, but the general lesson of the experiment is that nitrogen fertilisers, while they caused increase in growth, did not increase, but actually decreased, the fruit. With tomatoes of the Comet variety the results were:—

	Lb. per Plant.				Tons per Acre				Relative Weights. Average 1916-19.
	1916.	1917.	1918.	1919.	1916.	1917.	1918.	1919.	
Complete artificials ..	4.9	5.11	5.32	5.57	38.7	35.8	26.8	42.2	109
No nitrogen ..	5.7	5.80	5.62	5.96	45.0	39.2	28.2	47.4	111

The second important point is that potassium compounds increase the vigour of the plants and enable them more readily to resist disease; this is generally known to many growers. Flax growers in the North of Ireland have found that potassic ferti-

* Rating tobacco at 15 cents per lb.; wheat at \$2.00 per bush.; and hay at \$20.00 per ton.

lisers increase the resistance of the plant to the attacks of the wilt organism.

At the Cheshunt Experimental Station liberal treatment with potassic fertilisers makes the tomato plant more resistant to the bacterial stripe disease: the numbers of plants affected out of a total of 120 in each plot were* :—

Variety.			Complete Fertiliser.	No Potassic Fertiliser.
Comet ...	...	...	40	78
Kondine Red ...	...	...	13	33

Potassic fertilisers often afford the simplest method of dealing with fungoid diseases, and they are usually more effective than other fertilisers under glass.

Are Mineral Phosphates Effective as Fertilisers?—This question is now being asked by a number of farmers, and details of some of the experiments are given from time to time in these notes. Broadly speaking the result at present is: *Where basic slag cannot be obtained in sufficient quantity it is worth while trying mineral phosphates, provided that they are sufficiently finely ground.* Judging from the trials already made there is reason to expect that they will prove useful on heavy clay grazing land where the herbage is in poor condition. They may also prove useful (though the evidence at present is not complete) on arable land for the growth of swedes and turnips. Judging from foreign experience they should also prove useful on sour soils badly deficient in lime.

* S. G. Paine and F. W. Bewley, *Annals of Applied Biology*, 1919, 6, 185.

FEEDING STUFFS IN JANUARY.

E. T. HALNAN, M.A.,

Ministry of Agriculture and Fisheries.

It will be noted in scanning the table of prices appended that the price per unit of food value of various feeding stuffs differs greatly. It may be as well to consider the causes responsible for these variations.

The guiding principles which govern the price of a feeding stuff (apart from the question of supply and demand) are (1) its food and manurial values, (2) its appearance, (3) convenience of feeding, (4) its dietetic and condimental values, (5) its palatableness, (6) and last, but not least, its wholesomeness.

(1) Full information on the *food value* of the various concentrated feeding stuffs on offer in the markets and the relative money values of the various foods on offer are summed up in the table on p. 965. In the footnote is given a method whereby the farmer may distinguish which of any foods he contemplates purchasing is the cheapest from the food standpoint.

(2) The *appearance* of a food generally weighs much too heavily in the mind of the buyer when making a purchase. A food with a pleasing and attractive appearance often commands a better price owing to this. A case in point is the differential price generally ruling for bran and broad bran. In one instance two earth nut cakes were on offer, with a difference in price per ton of nearly 20s., though the cheaper and less attractive cake was actually of better feeding value than the more attractive and expensive one.

(3) In view of present labour conditions the *convenience of feeding* is an important point that the practical feeder cannot neglect. Cakes are generally much easier to feed than meals, and the feeder must decide for himself how much more per ton he is prepared to pay for this convenience.

(4) The *dietetic value* of a food is an extremely important point of which all feeders are well aware. In fact, it is generally lack of knowledge of this point that makes feeders cling to old-established feeding stuffs and makes them doubtful of using new ones. The result of this is to depress all unfamiliar feeding stuffs below their true market value, and it is in this direction that practical progressive farmers may reap the advantage of low prices. In this connection, wrong feeding often creates an unwarranted prejudice against a feeding stuff. The ancient

NAME.	Price per Qr.		Price per Ton.		Manurial Value per Ton.		Food Value per Ton.		Starch Equiv. per 100 lb.		Price per Unit, Starch Equiv.		Price per lb. Starch Equiv.	
	s.	lb.	£	s.	£	s.	£	s.	s.	d.	s.	d.	s.	d.
Barley, English Feeding	70/-	400	19	12	1	6	18	6	71	5/2		2.77		
" Foreign	62/-	400	17	17	1	6	16	11	71	4/8		2.50		
Oats, English	50/-	336	12	13	1	9	15	4	59.5	5/1		2.73		
" Foreign	46/-	320	16	2	1	9	14	13	59.5	4/10		2.59		
Maize	56/-	480	13	1	1	5	11	16	81	2/11		1.56		
Beans, English spring	90/-	532	18	19	3	1	15	18	66	4/10		2.59		
" winter	86/-	532	18	2	3	1	15	1	66	4/7		2.45		
" Chinese	18/-	112	18	0	3	1	14	19	66	4/5		2.28		
Peas, English blue	135/-	504	30	0	2	13	27	7	69	7/11		4.24		
" dun	85/-	504	18	18	2	13	16	5	69	4/8		2.50		
" maple	95/-	504	21	2	2	13	18	9	69	5/4		2.86		
" Japanese	132/6	504	29	9	2	13	26	16	69	7/9		4.15		
Buckwheat	84/-	392	24	0	—	—	—	—	—	—		—		
Rye, English	84/-	480	19	12	1	8	18	4	72	5/1		2.73		
Millers' offals—Bran	—	—	13	10	2	10	11	0	45	4/11		2.63		
" Coarse middlings	—	—	14	10	2	10	12	0	64	3/9		2.01		
Barley meal	—	—	22	0	1	6	20	14	71	5/10		3.12		
Maize "	—	—	16	0	1	5	14	15	81	3/8		1.96		
Bean "	—	—	21	0	3	1	17	19	66	5/5		2.90		
Fish "	—	—	24	10	7	12	16	18	53	6/3		3.35		
Cakes, Linseed	—	—	19	10	3	12	15	18	74	4/2		2.23		
" Soya	—	—	—	—	5	4	—	—	69	—		—		
" Cotton seed	—	—	13	0	3	5	9	15	42	4/8		2.50		
" Cotton seed de- corticated	—	—	20	0	5	6	14	14	71	4/2		2.23		
" " decorticated meal	—	—	18	0	5	6	12	14	71	3/7		1.92		
Coconut cake	—	—	15	19	3	0	12	19	79	3/3		1.74		
Groundnut cake	—	—	15	15	3	9	12	6	57	4/4		2.25		
" decorticated	—	—	18	0	5	5	12	15	73	3/6		1.87		
Palm kernel cake	—	—	11	15	2	1	9	14	75	2/7		1.38		
" " meal	—	—	10	0	2	1	7	19	75	2/1		1.11		
Brewers' grains, dry	—	—	10	10	2	7	8	3	49	3/4		1.78		
" " wet	—	—	1	7	0	12	0	15	15	1/-		0.53		
Distillers' " dry	—	—	11	11	2	16	8	15	57	3/1		1.65		
" " wet	—	—	1	9	0	13	0	16	16	1/-		0.53		
Malt culms	—	—	10	2	3	6	6	16	43	3/1		1.65		
Potatoes	—	—	*3	0	0	8	2	12	18	2/11		1.56		
Swedes	—	—	*1	4	0	5	0	19	7	2/11		1.56		
Mangold	—	—	*1	3	0	6	0	17	6	2/11		1.56		

* Consuming value.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in the larger markets, usually London, and refer to the price ex mill or store. They are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £15 per ton. Its manurial value is £2 1s. per ton. The food value per ton is therefore £12 19s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 3s. 6d. Dividing this again by 22.4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1.88d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

dislike to decorticated cotton cake was undoubtedly due to the fact that, owing to ignorance, too heavy a quantity of this feeding stuff was included in the ration, and digestive troubles resulted.

It might be well to emphasise once more that linseed cake, soya bean cake and bran have a laxative effect, whereas common cotton cake and beans are distinctly binding.

(5) With regard to *palatableness*, too much attention may easily be paid to this point. The eagerness with which stock will consume any given feeding stuff is no true criterion of its feeding value. Stock will consume most feeding stuffs if sufficient attention is paid to method of feeding, and if care is taken to introduce any change in diet gradually.

(6) The question of *wholesomeness* of a feeding stuff is one to which the feeder cannot pay too much attention. Linseed cake, oats and bran at once suggest themselves as suitable feeding stuffs for most purposes. Stock feeders use such feeding stuffs with confidence, but they do not readily use such feeding stuffs as palm kernel cake, sesame cake, and soya bean cake, although these three cakes are quite wholesome if care is taken to feed in judicious quantities. Some feeding stuffs occasionally contain poison, and it is especially necessary to act with caution whenever a new feeding stuff is on trial, or in any case where the cake fed is not in good condition. The golden rule in such a case is to feed first in small quantities and to one animal.

Since last month feeding stuffs have fallen considerably in price. Wet brewers' and distillers' grains still remain the cheapest feeding stuffs, and palm kernel cake and meal and maize are very profitable at present prices.

NOTES ON POULTRY KEEPING.

Feeding in January and February.—The most expensive period of the year for poultry keepers is well advanced, and with the season of maximum egg production approaching, the outlook is still further improved by the prospect of better supplies of feeding-stuffs.

There are now ample supplies of most poultry feeding-stuffs, and although little improvement is apparent in the quality of middlings, much of the bran is better than has been the case for a considerable period.

Maize and its by-products are plentiful. Much of the old prejudice against maize feeding has been broken down, and cracked maize is now more generally used in suitable proportions and is more easily obtained. A warning should be given against damaged samples. These mostly find their way into mixtures, so that particular care should be taken by poultry keepers when purchasing grain mixtures.

The prices at which clover meal is offered are frequently far above its value, and, judging by the poor quality of some samples (many of which are practically valueless for poultry feeding), it is evident that some vendors are taking an unfair advantage of the growing popularity of clover meal as a poultry food.

Purchasers of fish meal should exercise due caution, as although the dangers from the presence of excessive salt have been reduced by frequent warnings, it is still very necessary to watch for the presence of worthless material.

Breeding Stock.—Stock should be liberally fed, but it is necessary not to unduly force the birds for eggs. Fish or meat meal should only be used in moderate proportions in the wet or dry mash, and a plentiful supply of vegetables, either cooked or in a raw state, should be allowed. A grain mixture consisting of good heavy oats and about 25 per cent. of maize is suitable for cold weather. Wheat alone, especially if containing much dirt, &c., is not good for winter egg production. Particular care should be taken to ensure that the male birds in breeding pens secure a sufficiency of food, and it is recommended that they should be fed apart from the hens in some instances, as this will amply repay the additional trouble occasioned.

Laying Stock.—The disposal by now of all surplus and unprofitable stock will have reduced the laying flocks to suitable

proportions for the accommodation available, and with the exception of the later hatched birds the pullets will be in full lay.

Where dry mash feeding is practised there is less likelihood of the birds being underfed provided the material in the mash is of good quality. Good results in egg production can be secured with either the "wet mash" or "dry mash" system of feeding if properly carried out, but in order to reduce the grain bill the feeding of dry bran in hoppers (constructed to avoid waste) is an economical addition where wet mash feeding is practised. Care must be taken to encourage activity and provide occupation for the birds whatever method of feeding is adopted. In the absence of fresh green food, turnips or swedes can be given. Beetroot and artichokes are also valuable and are greatly appreciated by the birds.

Chicken Feeding.—The earlier batches of chickens generally thrive better than the later batches, several factors being responsible for this. More care is taken in the preparation of wet mashes, and these are not given when stale and sour as they frequently are later in the season. Cracked wheat and groats, or coarse oatmeal should form the basis of all dry chicken mixtures. Kibbled maize and canary seed can be added to provide variety, which is an advantage, but the chicks do not always take readily to maize, and canary seed is expensive unless of really good quality. Whilst variety in the food is good this is frequently obtained at the expense of quality, and too much importance should not be attached to it. Mixtures are frequently wasteful and extravagant owing to the poor quality of some of the ingredients. The more general use of Sussex ground oats in a wet or dry mash is to be recommended, especially in view of the poor quality of the middlings. A small proportion of maize meal mixed with the ground oats is an advantage in the preparation of a wet or dry mash. Boiled rice is a valuable food as a safeguard against bowel disorders, from which large numbers of chickens perish, and it is an advantage if the rice is boiled in separated milk. Green food should not be omitted from the diet, and is better if finely chopped for little chicks. In the absence of young fresh green food, or in addition to this, chopped raw onion is a valuable substitute and should be mixed with the mash.

Notes on Essential Points in Poultry Feeding.*—It is more profitable to maintain a few well-fed birds than a large number

*This note is also issued as Leaflet No. 321 as recently re-written.

of badly fed birds. Poultry will not give a satisfactory return unless their food is sufficient and of a suitable nature, and is also both varied and palatable.

Poultry require (I) grain, whole or in the form of meals or offals; (II) animal food; (III) green food.

Grain.—Oats and maize are among the most suitable grains for poultry under existing food conditions. The former should be of good quality, as light oats are very wasteful. Maize must be used in moderation; it is better cracked; and it is a most valuable food in wet and cold weather when the birds are exposed.

Meals, Offals, &c.—Bran and middlings are the staple constituents of dry and wet mashers respectively, and may form up to 50 per cent. by weight of the mash. Sussex ground oats, maize meal, barley meal and palm kernel meal may be used in proportions not exceeding 25 per cent. by weight of the mash. Clover meal of good quality forms a useful substitute if the supply of green food is insufficient, but it is difficult to obtain.

Animal Food.—As a rule poultry upon free range will find abundant insect life between March and November. During the remaining months, and at all seasons when not available from natural sources, a moderate proportion of animal food should be provided. Lack of animal food frequently accounts for the absence of eggs from well-developed pullets.

Fresh horse-flesh, meat offals or blood are all of the greatest value if procurable easily, cheaply and regularly, but they should be used in limited quantities. Meat meal and fish meal are the most convenient forms of animal food for the majority of poultry keepers, and are generally more readily obtained. They may be given in amounts not exceeding $\frac{1}{2}$ oz. per bird daily mixed with all meals.

Green Food.—A regular and plentiful supply of fresh vegetable food should be given to birds on limited range. Upon free range there is generally sufficient for their needs, except during the winter months, when waste from the garden, or roots, swedes or mangolds should be supplied.

Preparation of Wet Mash.—Meals (including fish and meat meals) should be first scalded with the liquid in which vegetables have been cooked and then allowed to stand for a few minutes. Vegetables and cooked meat should be pulped or finely chopped before being added to the mash. The

middlings should then be well mixed in by hand, until the whole mash is in a dry crumbly condition; the mash should then be fed to the birds while still warm.

Wet mash may be given either as a morning or evening feed and should be fed in troughs to avoid dirt and waste.

Dry Mash.—For birds upon a limited range dry mash feeding has much to recommend it. If the mash is given in properly constructed hoppers or troughs there need be little waste, and, by placing it before the birds almost continuously, the birds can secure sufficient food and are at the same time kept busy. The ingredients should be purchased separately and mixed in bulk.

Grit.—Grit composed of some hard material, such as flint cracked to the size of peas, is required to assist the fowls to digest their food, and should always be available.

Shell.—Either oyster or cockle shell is needed by laying hens to provide material for the formation of egg shells.

Water.—Fresh water should always be provided in unlimited quantity.

* * * * *

National Egg-Laying Test at Dodnash Priory.—The National Utility Poultry Society, in conjunction with the Great Eastern Railway Company, carried out during 1919-20 an egg-laying test at Dodnash Priory, Bentley, near Ipswich, extending over a period of 48 weeks. In all, 280 pens were entered for the competition, and were divided into six sections: (1) White Leghorns; (2) White Wyandottes; (3) Rhode Island Reds; (4) any sitting (other than Wyandottes and R.I. Reds); (5) any non-sitting breed (other than White Leghorns); (6) a championship section for White Leghorns, White Wyandottes, and Light Sussex, limited to breeders who had won one gold or two silver medals in previous tests.

The eggs laid were classified by the Society into two grades: Grade 1, eggs weighing 2 oz. and over; and Grade 2, eggs weighing less than 2 oz. but not less than 1½ oz. during the first 10 weeks, and for the subsequent period not less than 1¾ oz. For the purposes of the competition, however, not more than 100 second-grade eggs, or in the case of the championship section not more than 200 second-grade eggs, were allowed to be included in the pen score.

The following table shows the egg totals for the test for the whole of the period:—

Egg Totals for the whole period of the Test.

Died during Test.	No. of Birds.	Breed.	Eggs Laid.		Total.	Average Yield per Bird for 12 Months.
			1st.	2nd.		
21	570	White Leghorns	80,572	16,938	97,510	173
23	440	White Wyandottes	48,494	21,711	70,205	162
9	155	Rhode Island Reds	19,696	3,420	23,116	152
4	45	Buff Orpingtons	4,440	2,429	6,869	157
—	5	White Orpingtons	652	98	750	150
3	45	Light Sussex	4,352	863	5,215	118
—	15	Speckled Sussex	1,616	322	1,938	129
1	15	Buff Plymouth Rocks	1,605	413	2,018	135
—	5	Croad Langshans	780	85	865	173
—	55	Anconas	7,789	737	8,526	155
6	65	Black Leghorns	8,757	740	9,497	152
—	5	Black Minorcas	593	87	680	136
—	5	Black La Bresse	614	328	942	188
1	5	White La Bresse	199	587	786	163
—	5	Russian Orloffs	706	7	713	143
—	5	Sicilian Buttercups	512	85	597	120
68	1,440	All the birds	181,377	48,850	230,227	163
		Unrecorded eggs	.	..	1,119	
		Eggs under size (not scored)		.	431	
		Total ...	..		231,777	

The egg production of the five leading pens in each of the six sections was as stated below. Each pen consisted of five pullets, except in the case of the Championship Section, where there were 10 pullets to the pen :—

Breed.	Average Number of Eggs per Bird.
1. White Leghorns	208, 205, 203, 198, 195
2. White Wyandottes	199, 189, 206, 183, 167
3. Rhode Island Reds	205, 194, 175, 173, 183
4. Sitting Breeds	173, 167, 150, 146, 162
5. Non-sitting Breeds	210, 177, 177, 171, 168
6. Championship—White Leghorns ...	215, 181, 217, 183, 184

World's Poultry Congress.—Arrangements are sufficiently forward to make public the general arrangements for the first World's Poultry Congress which, by invitation of the Netherlands Government, is to be held at the Hague, Holland, from 6th to 13th September, 1921.

Congress Committees have been formed in the following countries : Belgium, Canada, Czecho-Slovakia, Denmark, France, Great Britain and Ireland, Italy, Norway, Portugal, Sweden and the United States of America.

A preliminary programme will shortly be issued giving details as to arrangements already made, lists of papers to be read, and

information for those who desire to participate in the Congress. Every provision will be made with regard to routes by which the Hague can be reached, special terms at hotels, &c. Copies of the preliminary programme and regulations for Exhibition to be held at the same time, when issued, can be obtained from the Secretaries, British Congress Committee, 3, Vincent Square, London, S.W.1, to whom application for membership should be made.

Papers have been promised by many of the leading authorities in the poultry world, and by scientific investigators in various countries.

All Government Departments concerned in poultry work, Public Authorities and Institutions engaged in poultry instruction or in research and experimental work, poultry and other societies and trading firms or societies may appoint delegates, and private individuals who may wish to become members may do so. A fee of £1, or 12 Dutch guilders, will be charged for each delegate or member, and will entitle the holder to all privileges of the Congress, including a copy of the Report.

It is anticipated that the Demonstration Exhibition will include representative breeds of poultry from nearly all countries throughout the world, displays by educational and scientific institutions, examples of appliances and apparatus used for production, education and commerce, models, books, bulletins, diagrams, photographs, food products, &c. Several Governments have intimated their intention of co-operating in the Exhibition.

REPAIR AND MAINTENANCE OF THRESHING MACHINES.

DURING and since the War, the state of threshing machinery has considerably deteriorated owing to lack of labour and materials necessary for repairs, and to the fact (due to scarcity and high cost) that only a small number of new machines have come into use.

In view of the great difficulty being experienced by threshing machine proprietors, and more especially the smaller contractors, in procuring efficient men capable of executing repairs necessary to keep existing plant in a proper state of efficiency, the Ministry has thought it desirable to issue a few simple instructions, in the hope that they will prove to be of assistance to those who are not conversant with the essential working parts of a threshing machine.

There are in use to-day many machines which have had from twenty-five to thirty years' wear, but are still in good order—a result entirely due to their having been maintained in efficient condition and worked by careful attendants.

Suggestions for Threshing Machine Owners.—The points needing most attention are as follows:—

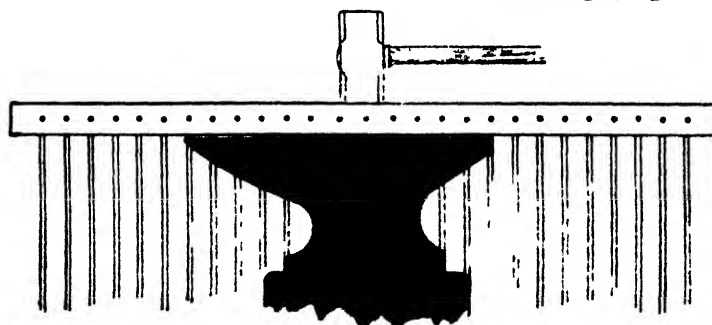
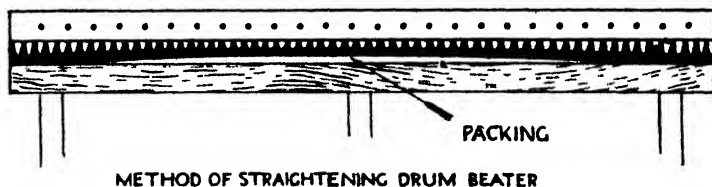
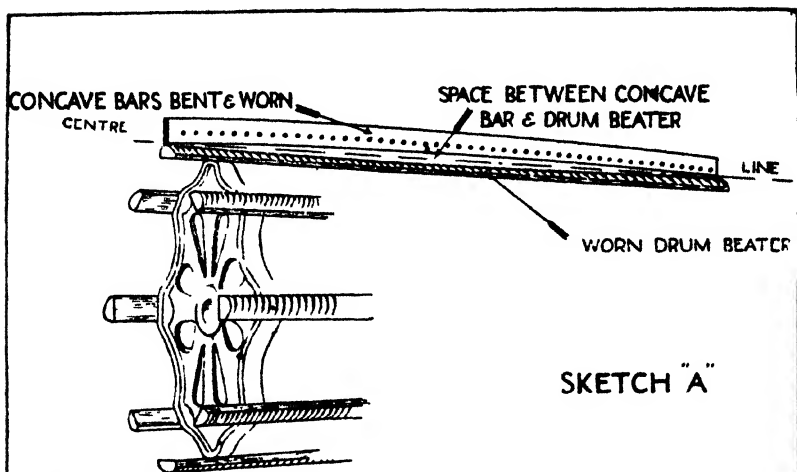
Setting.—It is frequently noticed that machines are set for use without proper regard having been paid to the formation of ground on which the machine stands. All threshing machines are constructed so that the drum runs level, and unless this position obtains, the work suffers in consequence.

Drum—The beaters of the drum and the bars of the concave have a tendency to wear in the centre and become hollow, thereby making the drum more open at the place where most of the threshing is done, with the result that grain is left in the straw; the drum may also become so close at the ends that the corn is likely to be split (*see Sketch A*). When this occurs it is desirable to take the beaters off and pack them up in the centre with cardboard, or other suitable packing material, until they are again in a straight line (*see Sketch B*). This can be only done once; when worn down a second time they should be replaced by new parts. Spares of this nature should be kept always available.

The drum bearings and spindle should be kept in good condition and the drum properly balanced

The concave bars have a tendency to get worn off on the top edge, and when this happens the bars should be taken out and turned, thereby bringing the square edge to the top.

Bent bars may be straightened on an anvil, as shown in Sketch C. In modern threshing machines the concaves are



reversible, which exposes the opposite side of the concave bars to wear, but a time will come when the concave wires will have so worn that it is desirable to renew the concave.

Straw Shakers and Riddle Cranks.—The bearings of the straw shakers should be adjusted, and attention given to the small cross bars, which are likely to get broken off, thereby increasing the amount of cavings passing through. In old machines shaker blocks are generally of wood, and wear and tear must be taken up and adjusted.

Riddles and Siences.—These should have attention. Care should be taken to see that there are no holes worn in them, and no places where the corn leaks out on the ground. Damage is frequently caused by impatient attendants endeavouring to clear a choked riddle, when in motion, by a thatch pin or any other similar article near to hand.

Screen—The adjustable screen is likely to get out of order through being closed with corn or other matter between the wires; the wires get bent, leaving open spaces and in some cases they become unsoldered from the expanding frame. If the screen is in bad condition it is impossible to get an even sample of corn without an undue proportion of good corn going into the tailings. It is preferable to send it back to the makers to be repaired.

Straps and Belts—All straps and belts should be maintained in good condition and with as few buckles and lacings as possible. It is also desirable to see that the shaker and riddle belts are kept fairly tight, otherwise there may be an unobserved loss of efficiency through slipping.

Self-Feeders.—Efficient feeders are often difficult to secure, and when this difficulty is experienced, contractors are advised to try self-feeding apparatus, which in some districts is coming into use.

Engine.—Owing to the high price of fuel, it is desirable that the steam engine should be maintained so as to give as economical results as possible. If the piston or slide valve is passing steam it should have attention immediately.

Mechanical forced feed oil pumps for lubricating the slide valve and piston are most essential.

The exhaust pipe, when using mineral cylinder oil, is likely to fur up and become contracted. This throttles the exhaust, reduces the power of the engine, and increases steam consumption. It should therefore be kept thoroughly clean.

In districts where bad water prevails, it is desirable that the boiler tubes should be withdrawn at frequent intervals,

as heavy incrustations will increase the consumption of coal as much as 15 to 20 per cent. The smoke tubes should be swept out daily.

The engine governors should be kept in an efficient state of repair. Steady running of the machine results in good threshing. It is a wise precaution to keep a watchful eye on the governor strap. Instances occur of the strap breaking or coming off, allowing the engine to race, thereby wrecking the drum and concave by bursting through centrifugal force.

The most economical method of firing is to keep as thick a fire as the engine will steam with, being careful to fill in with coal any holes which burn through to the firebars. Firebars should be kept in good condition, so as to avoid waste in coal. Warped bars which permit fuel to fall through should be renewed. Steam should be kept as high as possible and the governors set accordingly, thereby ensuring dry steam.

Suggestions for Farmers.—Farmers are advised to give attention to the following:—

- (1) Carefully examine the straw by drawing the heads through the fingers to feel if any corn is left in it.
- (2) Examine the corn where the straw empties into the elevator, or on to the ground, to see if any corn is coming off the shaker with the straw.
- (3) Examine the cavings and chaff in a similar manner.
- (4) Attention should also be paid to adjustment of blower in order that seeds of weeds may be blown out. As much blast should be used as possible provided that no corn comes over with the cavings and chaff.
- (5) See that the screen is separating the corn properly and that no good corn is getting into the tail. Also note whether there is an undue amount of broken corn, caused by the drum being set too close. If barley and wheat are both being threshed, and in the latter the chaff adheres to the corn, the awner and piler require careful adjustment. In a dry season barley is often very much deteriorated for malting purposes through the ends being broken off by severe treatment of the awner and when passing through the piler blades. These latter can be regulated easily by the threshing machine man, but in some seasons it is advisable not to allow barley to pass through the awner as maltsters are unanimous that many good samples are ruined through the ends of kernels being bruised. It is preferable to leave a portion of awn on the kernel.

MOLE DRAINING.

THERE is no doubt whatever as to the value of drainage, especially on heavy land. On land that is badly drained the best type of herbage can never be obtained, while at the same time the grazing season is practically limited to the drier summer months. At other seasons stock cannot be carried on such land without grave risk both of illness and disease to themselves and of lasting damage to the texture of the soil.

In the case of arable land, work is retarded and rendered difficult and expensive. Crops cannot be depended upon. They have frequently to be sown out of season and are apt to fall an easy prey to various pests and diseases.

The present cost of laying down extensive systems of pipe drainage is very high, but on heavy clay soils quite as efficient, if not quite as permanent, drainage can be obtained at relatively little cost by the use of the mole plough. On such land mole drains will last from eight to ten years and under favourable conditions even twice as long. The inclusive cost (about 50s.-65s. per acre) is often fully recovered in the increased crops obtained the first year.

Mole draining is not adapted to every kind of soil, but wherever heavy clay land, to which it is specially adapted, is to be found, it deserves, as one of the cheapest and surest methods of improvement, full and careful trial. On more friable soils mole draining may be successful, but in such cases there must always be a good fall and intermediate main drains should be provided. There should be few, if any, stones so large that they cannot be turned aside by the coulter; and the ground must not be too uneven, as the drain will naturally follow the inequalities of the surface. If the field is laid up in ridges and furrows the drains must follow the line of the furrows and not run across them.

As regards fall, if a field has a sufficient fall on the surface for a water furrow to run, there will be sufficient fall for the proper working of a mole drain. Less fall is required on a heavy plastic clay than on a more friable soil, where water standing in the mole would tend to make the walls fall in.

The mole plough consists of a round steel plug about three inches in diameter attached to the lower end of a strong coulter which is fitted to a suitable frame mounted on wheels. It is worked, like an ordinary steam plough, by cable and winding drum.

There are two methods of proceeding. Either the moles are first run and then the mains are put in, or the mains are first laid and the moles run over them. In either case the work must be carefully planned beforehand.* If the moles are run first the mains should be laid with as little delay as possible. On lighter land and where the fall is slight it is better to lay the main drains before running the moles, otherwise a heavy shower may ruin the work completely. The advantage of running the moles first is that they can be cleared out with a stick as the mains are dug and a free outlet secured into the main. As a rule pipes are used for the mains and also for the beginning of each mole drain to make a good junction with the main.

Where the slopes drained by the moles are short, the mains may be laid with 2½-in. pipes, but where the slopes are longer 3-in. pipes should be used. The longer the slopes and the steeper the fall the more numerous should be the main outlets—at any rate there should always be at least one for every three acres.

The moles are sometimes started from holes, or “eyes,” into which the coulter, with the plug attached, is dropped; but often when the lie of the land and the lay-out of the proposed drains admit it, the mole is allowed to bury itself. If, for instance, the main runs parallel with the side of the field and not less than 14 yds. from it, the mole drain can begin at the surface and will have reached full depth by the time it crosses the line of the main.

The tunnel produced is very similar to a mole’s “run,” and if the subsoil is of the right texture and moistness, an efficient drain is obtained. The disturbance caused by the coulter itself is very small and as a rule the cut soon closes up. Even when a crop is being grown on the land the work may be done without causing any very serious damage, especially if done in dry weather and before the crop is more than a few inches high.

There should be a main drain along the bottom of the field; in the case of an uneven field main drains should be made along the hollows. For cutting the main drains, a drain-cutting machine, such as the Swedish “Revolt” excavator, will save

* It is a good plan, where mole draining has not been done before, to get a few hints from a steam plough foreman; he will often see reasons for putting in mains which have not occurred to the farmer.

For instance, in planning mains, it is well to know the extreme distance that the engine can cover in one pull. This seldom exceeds 200 yd. Attention to this and like points will often save much labour.

a considerable amount of hand labour. As a temporary measure main drains can be made by the mole plough and connected with a boundary ditch, or the mole drains can be run direct into a ditch. In this case, however, they should be protected, by the insertion of pipes, for two or three feet from the outfall; but it is not advisable to do without a main drain. A number of mole drains running into an open ditch will require more labour to keep clean than is likely to be available, and as some width of headland must generally be left for the engine to stand on, it is not always possible to run the moles direct into a ditch. Where it is desired to save expense, Faggot, or Bush Drains, as described in the Ministry's F.P. Leaflet No. 62. are sometimes used. Sometimes pipe draining is combined with bush draining. The main drain is dug about a foot deeper than the moles are to be driven, and filled in above the pipes with brushwood up to the level of the moles. When this is put in before the moles are drawn it should consist of twigs not more than 1 in. in diameter. The coulter will cut through these quite easily. When considering how deep to set the coulter of the drainer care should be taken to put it at the minimum depth of the mains, as these will of necessity be a few inches shallower in some places than in others.

A main drain should always have a cheap facing of brick or stone round the last pipe. This prevents damage and serves to mark the outfall.

The mole drains are usually made about 2 ft. in depth and about 5 yd. apart. Where the field is laid up in ridges or stitches the distance between the moles is usually determined by the distance between the furrows, but this is not always a certain guide, as the nature and lie of the land may require more drains. In fields where the water percolates to the subsoil very slowly, it is best to put in the mole drains fairly close, say, about 3 yd. apart, and not deeper than about 18 in. or 20 in.

It is most important that a plan of each field should be kept, showing the mains and their shallowest points. Such a plan will be useful in case the field should be moled again.

In Essex, where a good deal of mole drainage is performed annually, it is the custom for the tenant to carry out the work and the landlord to find the pipes for the main drains. In cases where the tenant leaves his farm after doing the work, compensation is generally given on a basis of three to six years.

(This article is also issued by the Ministry as Leaflet No. 356.)

AGRICULTURE ABROAD.

WOOL AND LEATHER IN CHINA—SEED CLEANING IN FRANCE—PRODUCE ON LARGE AND SMALL HOLDINGS IN RUMANIA.

A Wool and Leather Industries Commission was formally instituted at Peking on 1st June, and the President of the Chinese Republic has appointed Mr. Siung Ship Yi as President.

**Wool and
Leather Industries
Commission in
China.**

The functions of this Commission are, *inter alia*, as follows:—

1. To locate the regions best suited for raising cattle and sheep and to study the present output, quality, demand, and transportation facilities of wool and leather in these regions.

2. To ascertain the quantity and kinds of wool and leather required by foreign countries and to study the world's trade conditions concerning wool and leather.

3. To introduce and to encourage scientific stock raising.

4. To formulate methods of rendering assistance to the people in their enterprises as described in (3).

5. To select and purchase the best domestic and foreign breeds of cattle and sheep, which are to be sold at cost to the breeders.

6. To train technical assistants for cattle and sheep raising and wool and leather making, and also to study the methods of providing for hygienic conditions for domestic animals.

7. To establish breeding farms, wool and leather factories and laboratories, and make a comparative study of the different machinery and equipments used in the wool and leather industries and of the methods of marketing the products.

8. To devise methods of inspecting the quality of wool and leather to be exported.

9. To gather information and to receive reports on wool and leather industries from different provinces; to translate foreign technical books; and to publish magazines and bulletins concerning these industries.

10. To send out from time to time parties of experts to lecture in various cattle and sheep raising districts, in order to accelerate the development of wool and leather industries.

The Ministry has forwarded to the Commission particulars of

the various British breeds of live stock and the names of Secretaries of Breed Societies in this country.

* * * * *

MENTION has been made at various times in the *Journal d'Agriculture Pratique*, and also recently in the *Comptes Rendus*

**Seed Cleaning
in France.**

of the French Academy (issue of 14th April, 1920), of methods of cleaning cereals by mechanical operation. It is pointed out that experiment has shown that increased yields may be obtained by sowing seed previously cleaned, and machines have been designed to perform the cleaning process. These machines are well known among the larger farmers, but are little used on small holdings on account of their high price. It is noted that when cleaned cereal seed is sown, the number of weeds in the crop is reduced and increased yields are obtained.

In order to demonstrate the value of the machines used, a travelling seed-cleaning installation, consisting of different types of seed-cleaning machines, lent by the manufacturers of the machines, was recently exhibited on a car provided by the Paris-Orleans Railway, which made an itinerary of the two Departments served by the railway. A programme of the stations to be visited was drawn up, and notices of the stopping places of the car were sent out in advance. Farmers were invited to bring quantities of cereal seed to be cleaned, and many lots were so treated and several machines sold.

Where seed wheat of selected varieties furnished by large firms of seedsmen is not available, it is suggested that wheat of the previous harvest should not be sown "as threshed," but that it should be first properly cleaned.

A case of individual enterprise in the use of seed-cleaning machines is mentioned: A French farmer at Hailly (Oise), mounted a seed-cleaning machine on an ordinary motor waggon, and was thus able to arrange for its conveyance from one farm to another.

In order to a larger extent to remove the difficulty of high cost which has prevented the general adoption of the cleaning machines on small holdings, encouragement has been given to the idea of co-operation. So long as twenty years ago, co-operative use of cleaning machines was tried in the Department of Pas-de-Calais, and in 1908 a co-operative cleaning installation was established at Busy (Doubs). France is largely a country of small holdings, and in the co-operative

system undoubtedly lies a way to the solution to many problems of this nature.

It is frequently held that large holdings produce heavier crops than do small holdings, and this opinion appears to be borne out by the statistics of production published in Rumania.

**Comparison of
Produce on Large
and Small
Holdings in
Rumania.**

Taking the six years before the War (1909-1914) as a period of inquiry, and 100 hectares as the dividing line between large and small holdings, the Rumanian statistics show that the production of the four main cereals—wheat, oats, rye and barley—was greater on the large holdings than on the small holdings. The yields given in each case hereunder are in hectolitres per hectare.* Thus, in 1910, when the yield of wheat was heaviest for the six years mentioned above, the production on large holdings was 21.6 and on small holdings 18.3. Similarly, by taking the year in which the yield of each of the other cereals was heaviest, the statistics show that oats produced in 1913 on large holdings 27.2, and on small holdings 21.7; the yields for rye in 1910 were 19.3 and 15.3 respectively; while the barley production was in 1910 21.3 on large holdings and 18.0 on small holdings. Again, in considering the years when the yield of each crop was lowest, it is shown that, whilst in 1914 the production of wheat on large holdings was only 9.2, the yield of small holdings dropped to 7.4. Oats in 1909 show a yield of 22.4 for large holdings and 17.0 for small holdings. The figures for rye in 1914 are 9.1 for large holdings and 8.1 for small holdings. Finally, while the yield of barley in 1909 was 14.7 on large holdings, small holdings produced 12.1.

A similar result is obtained if potatoes and roots are added to the scope of the inquiry. The 1913 statistics show the same tendency; crops produced on large holdings are heavier than those produced on small holdings. In view of the splitting up of the large estates in Rumania into peasant holdings, it will be a matter of importance to those countries which have hitherto been receiving the exportable surplus of the Rumanian cereals whether such exportable surplus will be greatly reduced or wiped out, by the loss of production that appears always to occur under small holding management.

*1 hectolitre = $2\frac{1}{4}$ bushels; 1 hectare = $2\frac{1}{2}$ acres. To calculate the yield per acre quantities given should therefore be multiplied by 1.1.

Cost of Production of Winter Milk.—The experience of the War showed the great need for reliable statistical information as to the cost of production of the principal articles of agricultural produce, and with a view to obtaining such information, the Ministry of Agriculture and the Ministry of Food, early in 1919, set up a Committee, known as the Agricultural Costings Committee, to inquire into the costs and results of the various branches of farming. Among the tasks allotted to the Committee has been an investigation into the cost of milk production throughout Great Britain, which was undertaken at the request of the Food Controller.

The Committee is still engaged in its work, but an Interim Report (Cmd. 1028)* recently issued in respect of the first period of investigation, viz., 1st October, 1919, to 30th April, 1920.

The Report deals with 165 farms, of an average area of about 250 acres. The average number of cows kept per farm was about 36. In estimating cost of production, purchased foods have been taken at cost prices and home-grown foods at market prices less cost of marketing. It is pointed out that the prices at which home-grown foods are charged have a very important bearing on the figures arrived at.

The charge for wages includes the labour of feeding and attending to cows, both in milk and dry, and other dairy stock, but excludes delivery and retail labour and management charges, manual labour performed by the farmer and his family having being charged at the local rates of wages. Horse labour and labour of carting foods are charged in the costs at a uniform rate of 9d. per hour, while nothing is included in respect of interest on capital, and only £409 2s. 9d. is included for management charges where this sum was actually paid. In considering the margin of profit which should be allowed to the producer, interest on capital and an allowance for management should be kept in mind. The points above mentioned have obviously an important bearing on the interpretation of the figures.

Weight and Cost of Ration per Cow.—The following table shows the average ration fed and the average ration cost as between England and Wales and Scotland.—

	Average Weight of Ration per Cow per Day.		Average Cost of Ration per Cow per Day.		Average Cost of Ration per Gallon.	
	England and Wales.	Scotland.	England and Wales.	Scotland.	England and Wales.	Scotland.
	<i>lb.</i>	<i>lb.</i>	<i>pence.</i>	<i>pence.</i>	<i>pence.</i>	<i>pence.</i>
Purchased foods ...	9.9	16.1	14.9	14.9	10.1	9.5
Home-grown foods	53.1	73.1	30.1	25.6	20.4	16.3
Total ...	63.0	89.2	45.0	40.5	30.5	25.8
Grazing ...	—	—	.9	.2	.6	.1
			45.9	40.7	31.1	25.9
					Litter. .5	Litter. .3
					31.6	26.2

The cost in respect of home-grown foods fed to the cows for Great Britain during the period at average market prices works out per gallon of milk produced, as follows:—hay (at £14 6s. 5d. per ton) 7s. 2d., straw (at

* Obtainable from H. M. Stationery Office, Imperial House, Kingsway, London, W.C.2, price 2d., excluding postage.

£6 18s. 9d. per ton) 4d., roots (at £2 5s. 2d. per ton) 6·25d., and other foods (at £4 7s. 8d. per ton) 1s. 6d. The average total cost per gallon in respect of home-grown foods is therefore 1s. 7d., to which an addition of 0·4 pence should be made for litter.

Costs of Producing Milk at the Farms.—The average costs of producing a gallon of milk at the farms, taking into account labour expended on all stock in the herds, food and litter, general expenses, depreciation and maintenance of herds were:—in Great Britain 3s. 5½d., England and Wales 3s. 8d., and Scotland 3s. 0½d. Against these costs, however, must be set credits in the form of manurial values returned to the farm and amounts to be allowed in respect of other dairy stock. The credit figures for Great Britain, England and Wales, and Scotland were respectively 6½d., 6½d. and 6d. Thus the net costs of production for the three areas were:—2s. 11d., 3s. 1½d. and 2s. 6½d.

It will be observed that under the system of calculation adopted by the Committee, the home-grown food used was charged at market prices less cost of marketing. If therefore milk were sold at the prices indicated in the Report as the Cost of Production, the farmer would presumably realise a substantial profit on these home-produced foods.

Agricultural Research Scholarships.—The Ministry, on the recommendation of the Advisory Committee on Agricultural Science and with the concurrence of the Development Commissioners, has awarded Research Scholarships in Agricultural Science to the four undermentioned candidates:—

Mr. J. G. H. Frew, B.Sc. (Entomology) (Birmingham University).

Miss M. S. Lacey, B.Sc. (Plant Bacteriology) (Birkbeck College, London University).

Mr. J. C. Mann, B.A. (Animal Nutrition) (Cambridge University).

Mr. J. L. Rosedale, M.A. (Animal Nutrition) (Aberdeen University).

These scholarships, which are of the value of £200 per annum and are tenable for two years at such Institutions at home or abroad as may be approved by Ministry, have been established in order to train promising students—graduates of British Universities with honours in science or equivalent qualifications—with a view to their contributing to the development of agriculture by becoming research workers.

Tithe Redemption.—The Ministry of Agriculture and Fisheries gave notice early last month that landowners who proposed to redeem tithe rent charge under the conditions now in force should lodge their applications for redemption not later than the 1st January, 1921. Owing, however, to the recent rapid and very considerable increase in the number of applications received, it is inevitable that during the next few months some delay must occur in proceeding with the applications.

Leaflets issued by the Ministry.—Since the date of the list given on page 890 of last month's issue of this *Journal*, the information contained in the following leaflets has been revised and brought up to date:—

No. 25.—Chafer Beetles.

„ 61.—Sheep-Scab.

„ 142.—Calf Rearing.

„ 146.—The Value of Records of the Milk Yield of Cows.

„ 164.—Potato Leaf-Curl.

„ 264.—The Cultivation of Onions.

„ 267.—Basic Slag.

No. 282.—Scheme for the Improvement of Live Stock.

„ 296.—Potato Growing in Allotments and Small Gardens.

„ 335.—Potash Fertilisers.

„ 349.—Methods of Obtaining Strong Stocks of Bees for Over-Wintering.

The following leaflets have been withdrawn from circulation:—

Permanent Series—

No. 155.—Larch Canker.

„ 158.—White-Rot of the Vine.

„ 174.—Tree Root-rot.

„ 273.—“White-Heads” or “Take-All” of Wheat.

Food Production Series—

No. 5.—Breaking up Grass Land.

„ 13.—Comparative Money Values of Feeding Stuffs.

„ 23.—Blast Furnace Flue Dust as a Potash Fertiliser.

„ 27.—Potash Supplies during the War.

Special Series—

No. 34.—Autumn and Winter Fodder.

„ 60.—The Preparation of Home Made Rennet.

„ 76.—Feeding Stuffs and Live Stock.

Approximate Areas of Land at Different Altitudes.—In response to an enquiry, an approximate calculation has been made by the Ordnance Survey of the area of land in England, Wales and Scotland at different altitudes, after deducting the area of forest land and the area under cultivation.

	Total area.	Area after deducting Forests & Land under Cultivation.
<i>England.</i>	Square miles.	Square miles.
Above 500 and below 750 feet	5,907	5,607
„ 750 „ „ 1,000 „ „ „	2,407	2,027
„ 1,000 feet „ „ „ „ „	2,118	1,418
<i>Scotland</i>		
Above 500 and below 750 feet	7,448	6,648
„ 750 „ „ 1,000 „ „ „	3,726	3,026
„ 1,000 feet „ „ „ „ „	6,415	5,415
<i>Wales.</i>		
Above 500 and below 750 feet	1,706	1,620
„ 750 „ „ 1,000 „ „ „	853	810
„ 1,000 feet „ „ „ „ „	2,167	2,020

Rabies.—*Wiltshire, Dorset and Hants.*—Two extensions of the scheduled district have unfortunately been rendered necessary by the occurrence of outbreaks of Rabies. The first of these was confirmed on the 26th November, on premises at Wimborne. As Wimborne was situated on the borders of the Scheduled District, the District was extended so as to include Bournemouth and the neighbourhood. On the following day, disease was found to exist in a dog which was discovered straying at Compton, near Winchester. Enquiries elicited the fact that the dog had strayed from the premises of its owner in

Southampton and it was considered necessary further to extend the Scheduled District so as to include amongst other places Southampton and Winchester.

Further outbreaks were confirmed on the 7th and 13th December at Ramsbury and Baydon, Wilts, respectively, but neither of these cases necessitated any extension of restrictions.

Glamorgan.—A further case of Rabies was confirmed in the Glamorgan Hunt Kennels on the 20th December.

Berkshire.—Two outbreaks of Rabies have been confirmed in the borough of Reading on the 11th and 13th December respectively. Reading is in the district subject to the restrictions applicable to another controlled area, and the occurrence of these outbreaks did not necessitate any alteration of the restrictions.

London District.—A case of Rabies in a dog at Acton was confirmed on the 8th December. An Order has been made in consequence by the Ministry, requiring :

(a) The muzzling at all times and the leading when in a public place of all dogs in an Inner Controlled Area, and prohibiting entirely the movement of dogs out of this Inner Area.

(b) Prohibiting the movement of dogs out of an Outer Scheduled District surrounding the Inner Area.

Full information was issued to the press on 9th December.

Foot-and-Mouth Disease.—*Kent (Faversham District).*—All restrictions imposed on account of the outbreaks in the Faversham District were removed as from the 6th December.

Kent (Wingham District).—The existence of foot-and-mouth disease was confirmed on premises at Betteshanger on the 30th November, and it was necessary once more to impose the usual restrictions over an area within a radius of 15 miles from the infected premises. Fortunately no spread of the disease occurred, and the Ministry was able to modify the restrictions by the exclusion of a considerable portion of the Scheduled District as from the 7th December.

Hereford.—On the 12th December an outbreak of foot-and-mouth disease was confirmed on premises at Mordiford, near Hereford. The circumstances connected with this outbreak were serious, as animals which were recently exposed at Hereford and Shrewsbury Markets were infected. On the 14th December disease was found to exist at Ledbury and Lugwardine, Herefordshire, the origin being directly due to the Mordiford outbreak. Both these places were within the district to which the initial prohibition of movement restrictions were applied on the 12th December.

Gloucestershire.—On the 16th December two outbreaks of the disease were confirmed on premises at Woolridge, Hartpury, near Gloucester, in animals which had been in contact with the affected animals at Ledbury, Herefordshire, where disease was confirmed on the 14th December. These outbreaks necessitated an extension of the Herefordshire Scheduled District.

Shrewsbury.—On the 16th December two outbreaks were also confirmed in Salop, one at Myddle, and the other at Basechurch, both near Shrewsbury. In both cases the affected animals had been purchased in Shrewsbury Market on the 10th December and in Hereford Market on the 8th December, and had been in contact with one of the affected animals at Mordiford Farm, Herefordshire. An Order was made prohibiting movement of animals over an area of 15 miles radius from Shrewsbury.

ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous.

- Rothamsted Memoirs on Agricultural Science*.—Vol. ix., 1909—1916. (170 pp.). Harpenden: Rothamsted Experimental Station, 1919, 35s. net. [37(072).]
- National Farmers' Union*.—The Food of the People: The Nation and its greatest Industry. (35 pp.). London: Offices of the Farmers' Union, 1920, 2d. [338.1.]
- Martin, G.*—Animal and Vegetable Oils, Fats and Waxes. (218 pp.). London: Crosby, Lockwood & Son, 1920, 12s. 6d. net. [664.3.]
- Williams-Ellis, C.*—Cottage Building in Cob, Pisé, Chalk and Clay. (2nd Ed.), (136 pp.). London: "Country Life" Offices, 1920, 7s. 6d. net. [62'02.]
- Brenchley, W. E.*—Weeds of Farm Land. (239 pp.). London: Longmans, Green & Co., 1920 12s. 6d. net. [63.259(02)]

Field Crops.

- Carter, H. R.*—Flax and its Products. (311 pp.). Technical Handbook No. 8. London: Bale & Danielsson, Gt Tichfield St, 1920, 10s. 6d. net. [63 34111; 677.]

Horticulture.

- Davis, K. C.*—Farm Life Text Series: Horticulture. (416 pp.). Philadelphia and London: J. B. Lippincott & Co., n.d., 8s. 6d. [63 5(02).]
- Gardeners' Chronicle*.—The Calendar of Garden Operations (173 pp.). London: The Gardeners' Chronicle Offices, 1920, 2s. 6d. [63 5(02).]
- Seabrook, W. P.*—Modern Fruit Growing. (2nd Ed.), (176 pp.). Chelmsford: W. Seabrook & Sons, Ltd., 1919, 4s. 6d. net [63.41(02).]
- Sears, F. C.*—Productive Small Fruit Culture (Lippincott's Farm Manuals.) (368 pp.). Philadelphia and London: J. B. Lippincott & Co., 1920, 10s. 6d. [63 41(c).]
- Brown, Bliss S.*—Modern Fruit Marketing (283 pp.). New York: Orange Judd Co., 1916. [63.41-198.]
- Andrea, A. L.*—Home Bottling, Drying and Preserving. (124 pp) London: C. Arthur Pearson, Ltd., 1920, 2s. 6d. net. [664.85]
- New South Wales, Department of Agriculture*.—Farmers' Bull. 130 — The Packing of Fruit (46 pp) Sydney, 1920 [63 41-198]
- Wisconsin College of Agriculture*. Circular 120 — Freezing Injuries to Potato Tubers. (4 pp) 1919. [63 21; 63.512(04)]

Plant Diseases.

- Fryer, P. J.* Insect Pests and Fungus Diseases of Fruit and Hops. (728 pp.). London: Cambridge University Press, 1920, 45s. net. [63 24-41; 63 27 41; 63 294.]
- Western Australia, Department of Agriculture*.—Bull. 71:—Wheat Smuts and their Prevention, with Notes on Other Cereal Smuts and Ear Cockle. (44 pp.) Perth, 1920. [63.24-31]
- Virginia Truck Experiment Station*.—Bull 29 —Potato Spraying Experiments on the Control of the Pink and Green Aphid. (*Macrosiphum solanifolii*, Ashmead) (17 pp.). Norfolk, 1919. [63.294; 63.512(04)]

Live Stock.

- Dietrich, W.*—Swine: Breeding, Feeding and Management. (312 pp.). Chicago: Sanders Publishing Co., 1912. [63.64.]
- Davies, C. J.*—Goat-Keeping for Milk Production. (319 pp.). London: "Country Life" Offices, 1920, 10s. 6d. net. [63.63.]
- Wisconsin College of Agriculture*.—Circular 119:—Self-Feeders for Hogs. (15 pp.). 1919. [63.64.]
- Wisconsin College of Agriculture*.—Circular 131:—Pure-bred Bulls Pay. (16 pp.). 1920. [63.62.]
- U.S. Department of Agriculture*.—Circular 87:—Sweet-Clover-Seed Screenings not injurious to Sheep.—(7 pp.). Washington, 1920. [63.63.]
- U.S. Department of Agriculture*.—Farmers' Bull. 1090:—Rabbit Raising. (84 pp.). Washington, 1920. [63.69.]

Veterinary Science.

U.S. Department of Agriculture.—Farmers' Bull. 1065 :—Hog Lice and Hog Mange : Methods of Control and Eradication. (28 pp.) Washington, 1920. [63.64.]

U.S. Department of Agriculture.—Farmers' Bull. 1134 :—Castrating and Docking Lambs. (18 pp.). Washington, 1920. [619(09); 63.68.]

Storrs' Agricultural Experiment Station.—Bull. 103 :—Infectious Abortion in Cattle : Specific Measures of Control and Ultimate Eradication. (10 pp.). Connecticut, 1919. [619.2(a).]

Pennsylvania Department of Agriculture.—Gen. Bull. 323 :—Contagious Abortion of Cattle and the Uterine Douche Treatment. (18 pp.). Harrisburg, 1919. [619.2(a).]

Dairying and Food, General.

Ireland, Department of Agriculture and Technical Instruction.—Report of the Departmental Committee on the Decline of Dairying in Ireland. (31 pp.). H.M. Stationery Office, Dublin, 1920, 4d. net. [63.70(06).]

Knight, E. G., Freear, K., and Williams, R. S.—A Study of Factors concerned in the Production of Clean Milk. Part I. (8 pp.). London : P. S. King & Son, 1920, 1s. net. [614.32.]

Wisconsin Agricultural Experiment Station.—Bull. 315 :—Buttermilk Cheese and Cottage Cheese. (16 pp.). 1920. [63.73(04).]

Purdue University Agricultural Experiment Station.—Bull. 188 :—Cooling Cream on the Farm. (32 pp.). Lafayette, Ind., 1916. [63.713.]

Birds, Poultry and Bees.

Guénaut, G.—Ornithologie Agricole (396 pp.). Paris : J. B. Baillière et Fils. (Encyclopédie Agricole), 1920, 7fr. 50. [59.82.]

North of Scotland College of Agriculture.—Bull. 26 :—The Natural History of the Bee, *J. Anderson*. (28 pp.). Aberdeen, 1920. [63.81(04).]

North of Scotland College of Agriculture. Bull. 25 :—Some Hints for Prospective Bee-Keepers, *J. Anderson*. (8 pp.). Aberdeen, 1920. [63.81(04).]

North of Scotland College of Agriculture.—Bull. 27 :—How to Handle Bees, *J. Anderson*. (19 pp.). Aberdeen, 1920. [63.81(04).]

Engineering.

Ontario Department of Agriculture.—Bull. 277 :—Motor Transportation in Rural Ontario. (24 pp.). 1920. [388.]

Economics.

Green, F. E.—A History of the Agricultural Labourer, 1870—1920. (356 pp.). London : P. S. King & Son, 1920, 16s. net [331.]

Ditchfield, P. H.—Old Village Life (253 pp.). London : Methuen & Co., 1920, 7s. 6d. net. [333.5.]

Saint-Léon, E. M.—Syndicalisme Ouvrier et Syndicalisme Agricole. (160 pp.). Paris : Payot & Cie, 1920. [331.(44).]

Oxford University.—Oxford Tracts on Economic Subjects. Sets I—IV. London : Oxford University Press, 1920, 10½d. per set. [23.]

THE JOURNAL OF THE MINISTRY OF AGRICULTURE

Vol. XXVII. No. 11.

FEBRUARY, 1921.

NOTES FOR THE MONTH.

THE Ministry of Agriculture has now taken possession of the offices in Whitehall Place, which were occupied during the War by the Ministry of Munitions. These offices, which during their tenure by the Ministry of Munitions were known as Armament Buildings, were originally erected for the Ministry of Agriculture, and although there is not sufficient accommodation to house the whole of the present staff, their utilisation in conjunction with the old offices in Whitehall Place, enables most of the activities of the Ministry to be located in adjoining buildings.

The only portions of the Ministry which are now housed elsewhere are the Fisheries Division at 49, Parliament Street, and the Tithe Branch at 8, St. James's Square. The Agricultural Wages Board remains at 80, Pall Mall.

The Ministry's new telephone number is "Victoria 8700." The telegraphic address is "Growmore. Weststrand, London."

THE serious outbreaks of Foot-and-Mouth Disease which occurred towards the end of December and in January in the Midlands are remarkable from several circumstances. The disease appeared in areas hitherto free from such visitations, and when the Ministry inquired into the causes it became evident that the infection must have been communicated by sending animals affected by Foot-and-Mouth Disease to a public market. The result was that many animals from the market which had been exposed to the disease were distributed over wide areas, thus rendering the whole country liable to the risk of infection.

Foot-and-Mouth Disease would involve a large reduction of the milk supply as one of its many serious consequences, and it is imperative that all who keep or deal in live stock should watch most critically the condition of all cattle in their possession, especially if the animals are to be exposed at market. Should any suspicious symptoms be detected, it is the duty of the owner to report immediately to the Police. Such report, it should be noted, is required by law. The symptoms to be looked for particularly are lameness, slobbering at the mouth, and an affection of the mucous membrane of mouth and tongue. Stock-owners who fail in their duty in this matter not only incur the risk of heavy fines and even of imprisonment, but also do a grave disservice to their country. On the other hand, their active co-operation with the Ministry in the task of eradicating this dangerous disease is a national service of great importance. The Ministry's efforts are rendered ineffectual if those responsible for the care of live stock disregard the regulations and fail to report. The owner's duty is merely to notify suspicious cases to the Police; the Ministry does the rest. The initial step towards remedy lies with the owners; their help, therefore, is essential.

THERE is little doubt that the recent serious outbreaks of Rabies, which have necessitated the scheduling of enclosed areas in London and several English counties, are due only to neglect of regulations. The measures prescribed by the Diseases of Animals Acts are rendered useless if the public persists in careless disregard of precautions framed in the general interest. As long as dog-owners and others fail in their obvious duty, outbreaks of the disease must inevitably recur.

**Outbreaks of
Rabies: The Duty
of the Public.**

Careful observance of regulations, strict watch on the health of dogs, immediate report to the Police of any animals exhibiting suspicious symptoms will enable the trouble to be arrested. Dog-owners have the matter in their own hands, and if they will only cease to regard preventive measures as vexatious and unnecessary, and will do their best to aid the authorities, rabies would soon be unknown. Those who do not actually own dogs can also help by intelligent observation. Should they see a dog behaving in a suspicious manner, they ought to inform the Police, who will investigate the matter. Evasion of movement restrictions or muzzling orders cannot

be too severely condemned. It increases the risk of disease and augments a grave public peril.

* * * * *

With this issue of the *Journal* is published a supplement (No. 20) entitled "Seed Testing During 1919-1920" (Price

Journal Supplement on Official Seed Testing during 1919-20.

4d. post free, from the Secretary, Ministry of Agriculture and Fisheries, Publications Branch, 10, Whitehall Place, London, S.W.1).

This is the Third Annual Report of the Official Seed Testing Station and covers the period from 1st August, 1919, to the 31st July, 1920. A brief interim report on the work was published in the issue of this *Journal* for February last.

The total number of samples dealt with during the year ended 31st July, 1920, was 22,903, exclusive of 800 small packet samples received from the Seed Control Branch of the Ministry. This figure shows a decrease of 3 per cent. on the corresponding figure for last year, but owing to a considerable change in the nature of the samples tested, much more work has been involved.

It was estimated that about 30,000 samples would be received during the season, and but for a considerable drop in the number of cereal samples this figure would probably have been reached.

The following table indicates the sources from which the samples were received (the figures for the previous season being given for comparison):—

		1919-20.	1918-19.
Seed firms	... Number sending samples ...	751	808
	„ of samples received	18,696	13,450
Farmers, &c.	... „ sending samples ...	689	2,467
	„ of samples received	1,391	4,541
Public Depts.	... „ „ „ „	2,816	5,113
Total number of samples	... ..	22,903	23,604

A map included in the supplement compares to a certain extent with a map published in last year's report.* It is, however, of greater interest in that it shows directly the relation between the number of farmers in any county who have sent samples for test, and the acreage under arable cultivation.

The drop in the number of samples sent in by farmers is unsatisfactory, and makes it desirable to emphasise again that much more use of the seed testing facilities provided by the

* See this *Journal*, Vol. XXVI., p. 868.

Station might be made with advantage by the actual sowers of seed.

The general quality of the seeds examined during the period under consideration was good. It is satisfactory to note a gradual improvement in the quality of grass and clover seeds submitted for test, and that the proportion of English grown clover seed samples received at the station shows an increase over previous years.

NOTE.—It is hoped that the Seed Testing Station will have been moved to the National Institute of Agricultural Botany at Cambridge before the beginning of the 1921-22 season. The present address is 18, Leigham Court Road, Streatham Hill, London, S.W.16, to which all samples and communications relating to seed testing should be addressed.

Particulars as to size of sample required and fees payable are set forth in :—

- (a) *Food Production Leaflet No. 47*, (issued for the use of farmers). This leaflet also contains the text of the Testing of Seeds Order. Copies may be obtained on application to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1.
- (b) *Notice to Seedsmen (184/C.S.)*, obtainable from the Seed Testing Station.

THE Report on the Acreage and Live Stock Returns for 1920, which has just been issued by the Ministry, refers to

Acreage and Live Stock Returns. the large reduction in the acreage of crops and grass, which amounted in 1920 to 240,000 acres, following a similar loss in the preceding year. This represents a great acceleration in the reduction in the area of land used for agricultural purposes, which has been taking place for many years, and is attributed partly to the extension of building schemes in the last two years, but mainly to the fact that during the war a considerable area of agricultural land was taken for camps, aerodromes, munition works, &c. These deductions did not show themselves at the time, as concurrently additional areas of land were brought into cultivation. Following the cessation of hostilities some of this additional land, which had been used for food production merely as a war measure, was withdrawn, with the result that the loss of land for camps; munition works, &c., has now become manifest. Another cause of loss is the

extensive use of fields for allotments. The proportion of the cultivated area under the plough in 1920 was slightly less than in 1919, but was still somewhat greater than twenty years ago; while the proportion of the total cultivated area which was under corn was $24\frac{1}{2}$ per cent. against only $21\frac{1}{2}$ per cent. in 1914, and the proportion under other arable crops was well maintained. In comparing the acreage of crops in 1920 with the average of the three years 1911-13, it is shown that the acreage of corn per 1,000 acres of cultivated land was increased chiefly in the counties where the bulk of the land is under pasture, and showed least progress in the specially arable counties where the margin for possible extension is relatively small.

As regards the number of separate holdings, the Returns show that the number was increased in 1920 for the first time for several years, the number of small holdings being increased from 272,568 in 1919 to 274,796 in 1920.

Perhaps the most striking feature in the returns in 1920 was the heavy reduction in the number of cattle and sheep. The decline in the number of cattle was about 650,000, which was mainly due to a large reduction in the number of calves being reared as a result of the disproportionately high prices which were paid for calves for slaughter during the year. The number of cows and heifers in milk or in calf was, however, still at such a level that the herds of the country could be brought up to their recent numbers fairly quickly if farmers are convinced that the prices of meat and milk are such as will yield a moderate return for the capital and energy which must be invested in the enterprise. The number of sheep last year was the smallest on record, and the restoration of the flocks of the country to their former level must of necessity be slow as the ewe flock was correspondingly small; but the decontrol of prices of fat sheep which took place during 1920, combined with the high prices which flock-masters received for the wool clip of 1920, should encourage more breeding. Pigs, on the other hand, were increased in numbers, there being $15\frac{1}{2}$ per cent. more breeding sows in England and Wales in 1920 than in 1919.

THE AGRICULTURE ACT, 1920.

THE Agriculture Act, which received the Royal Assent on the 24th December last, came into operation on the 1st January. The Act consists of two main parts, of which the first contains amendments of the Corn Production Act, 1917, and the second contains amendments of the Agricultural Holdings Acts.

Part I.

1. Part I of the Act makes permanent the temporary provisions of the Corn Production Act, 1917, including the provisions as to agricultural wages and the enforcement of proper cultivation. Provision is, however, made for terminating the operation of that Act, as amended by this Act, by means of an Order in Council to be made on an Address presented to the Crown by both Houses of Parliament, but subject to the condition that the Order shall not take effect until the expiration of the fourth year after the date on which it is made. (Section 1.)

2. Instead of the fixed guaranteed minimum prices fixed by the Act of 1917, minimum prices in future are to be based on the following minimum prices for the standard year (1919), viz. : wheat 68s. per quarter of 504 lb., and oats 46s. per quarter of 336 lb. These are the minimum prices recommended by the Royal Commission on Agriculture and are based on the cost of production in the standard year. Minimum prices for 1921 and subsequent years are to be fixed by three Commissioners, and are to rise or fall in comparison with the above prices for the standard year in the same proportion as the cost of production rises or falls in comparison with the cost for the standard year. The Commissioners are to be appointed, one by the English and Scottish Departments of Agriculture jointly, one by the Treasury, and one by the Board of Trade. (Sections 2 and 3.)

3. The provisions of Section 9 of the Act of 1917, which deal with the enforcement of proper cultivation, are re-enacted with substantial modifications and amendments by Section 4. The principal amendments are as follows :—

- (a) The power to enforce the breaking up of pasture has been abandoned and the control of cultivation is limited to securing, by service of appropriate notices, the maintenance, so far as practicable, of land, whether arable or grass, "clean and in a good state of cultivation and fertility and in good condition," and the improvement of existing methods of cultivation, where production of food can in the national

interest be thereby maintained or increased "without injuriously affecting the persons interested in the land." A right of appeal to an arbitrator is provided to determine whether the notice is properly served. Such notice may not interfere with the discretion of the occupier as to the crops to be grown..

- (b) A new power is given to require the landlord or tenant according to their respective responsibilities to execute repairs which are necessary to secure proper cultivation. If a landlord is required to execute repairs and fails to comply, the tenant may be authorised by the Minister to execute the works and recover the cost from the landlord. Notices to execute repairs are also subject to an appeal to arbitration.
- (c) Unreasonable failure to comply with a notice served under this section is punishable by fine, and a County Agricultural Committee acting on behalf of the Minister is entitled to execute the work and recover the cost. This procedure is substituted for the provisions in the Act of 1917 enabling the Minister to determine tenancies or take possession in a case of default.
- (d) Cases have occurred in which good husbandry and food production have been prejudiced by the gross mismanagement of an estate, and the Minister is empowered in such cases, after consultation with the County Agricultural Committee and full inquiry, to make an order appointing a receiver and manager to act on behalf of the owner with wide powers of management. An appeal lies to the High Court against such an order.
- (e) Provision is made for dealing with the nuisance caused by the growth of weeds on land which cannot be dealt with under the provisions relating to the enforcement of good husbandry, on account of the land not being under cultivation, as, for instance, on roadside and railway embankments.

4. Section 6 establishes a separate agricultural wages administration for Wales on the lines of the Scottish scheme under the Act of 1917.

Part II.

5. The Act, whilst preserving in all circumstances the right of a landlord to give a tenant notice to quit, by Section 10 secures tenants against the loss consequent on eviction by extending the existing provisions with regard to recovery of compensation for disturbance. The general effect of the section is

that if a tenant is required to quit without any fault on his part, he will receive compensation for the loss, directly attributable to the quitting which is unavoidably incurred by sale or removal of his stock, &c., together with the expenses of the preparation of his claim. In order to simplify procedure and avoid disputes, this compensation is to be computed as equal to one year's rent of the holding, unless it is proved that the loss and expenses incurred exceed that amount, in which case the sum recoverable by the tenant will be the proved loss up to a maximum amount equal to two years' rent of the holding.

The Act, without setting up a rent tribunal, indirectly provides a method for readjustment of rent without the necessity of serving a notice to quit. The landlord will not be liable to pay compensation for disturbance if the tenant refuses to agree to an arbitration as to a proposed increase of rent and the landlord in consequence decides to determine his tenancy. On the other hand, the landlord will be liable to pay such compensation if he refuses a request by the tenant that there should be an arbitration as to a proposed reduction of rent and in consequence the tenant decides to leave.

The provisions of Section 10 are too long to be summarised in this Note, but an important provision is that which requires written notice by a tenant of his intention to claim compensation for disturbance to be given to the landlord one month before the termination of the tenancy.

6. Section 11 provides for payment of compensation for disturbance in the case of allotment gardens, to which the Agricultural Holdings Act, 1908, does not apply, and extends the Allotments and Cottage Gardens (Compensation for Crops) Act, 1887, to metropolitan allotments.

7. Section 12 applies to cottages on agricultural holdings which are held by agricultural labourers under the tenant of the holding the same principle of compensation for disturbance as is adopted in the Act as regards agricultural holdings, subject to certain special conditions.

8. Section 13 provides that a tenancy for a term of two years or upwards granted after the commencement of the Act shall continue as a yearly tenancy after the expiration of the term for which it was granted, unless a year's notice is given by either party of intention to terminate the tenancy. Any such notice given by the landlord may be the subject of a claim by the tenant to the benefit of the provisions of the Act relating to compensation for disturbance.

9. Section 14 removes a grievance in the case of a tenant of glebe land, who has hitherto been liable to removal in consequence of the death of the incumbent and places him in the same position with regard to compensation for disturbance as a tenant of other land.

10. Section 15 materially improves the position of a tenant as regards compensation for improvements. At present a tenant can only obtain compensation for permanent improvements if the landlord consents to their execution. Under the Act, if a landlord refuses consent to the making of any improvement, prescribed by regulation by the Minister as an improvement to which this provision is to apply, an arbitrator or the County Agricultural Committee can, after hearing the landlord's case, direct that the improvement shall be treated as an improvement for which consent is not required, but in that event the landlord will, as in the case of drainage, have the option of executing the improvement and charging an appropriate additional rent to the tenant.

As regards market garden improvements, the section contains provisions enabling an arbitrator or the Agricultural Committee to apply to a holding, or any part of a holding, the conditions known as "the Evesham Custom" under which the tenant who determines his tenancy is only entitled to compensation for market garden improvements if he can find another tenant willing to take his place and to undertake his liability for compensation.

11. Section 16 provides for compensation for a tenant who has continuously adopted a standard of farming or a system of farming which has been more beneficial to the holding than the standard or system (if any) required by his contract of tenancy. Section 19 provides a corresponding compensation for the landlord in the case of the deterioration of a holding by a tenant.

12. Section 18 enables a landlord to claim arbitration in respect of any breaches of contract by the tenant, and in this respect puts him in the same position as regards enforcement of his claims as that in which the tenant is under the Agricultural Holdings Act, 1908. All questions between landlord and tenant will be referable to arbitration, but particulars of a claim must be given within two months of the termination of the tenancy.

13. Under Section 28 notices to quit, other than a notice given by a tenant to a sub-tenant, if given after the 1st January, 1921, must be twelve month notices, unless the case falls within the

exceptions inserted in the section relating to land belonging to the War Departments, or to public undertakings, or where possession of land is resumed for purposes, other than agriculture, in accordance with a provision in the tenancy agreement.

14. In addition to the amendments specifically mentioned above, Part II of the Act comprises various other amendments of the Act of 1908, of a more technical character, which are desirable for improving the legal position as between landlord and tenant.

Part III.

15. Section 32 extends to cottages, provided free of rent for the use of an agricultural labourer as part of his remuneration, the statutory provisions which require cottages which are let to be kept reasonably fit for habitation.

The Act applies to Scotland with certain modifications, but does not apply to Ireland.*

* Copies of the Act may be purchased [price 6d., exclusive of postage] through any Bookseller or directly from H.M. Stationery Office at the following addresses:—Imperial House, Kingsway, London, W.C.2, and 28, Abingdon Street, London, S.W.1; 37, Peter Street, Manchester; 1, St. Andrew's Crescent, Cardiff, 23, Forth Street, Edinburgh; or from E. Ponsonby, Ltd., 116, Grafton Street, Dublin.

THE EMBARGO ON THE IMPORTATION OF CANADIAN STORE CATTLE.

DEPUTATION TO THE MINISTER OF AGRICULTURE.

THE Minister of Agriculture and Fisheries (The Right Hon. The Lord Lee of Fareham, G.B.E., K.C.B.) received on January 12th a deputation from the Joint Parliamentary Committee of the Co-operative Congress with regard to the existing embargo on the importation of Canadian store cattle. The deputation was introduced by Mr. A. V. Alexander, Secretary of the Joint Parliamentary Committee of the Co-operative Congress.

Mr. May, Joint Parliamentary Committee, in stating the case on behalf of the Co-operative Movement, drew attention to the fact that the movement represented upwards of 4,000,000 members. The risk of disease, it was urged, had long since been abandoned as a reason for the maintenance of the embargo; indeed the clean bill of health of Canadian cattle was unexampled in the history of that or any other country. Even if there had been disease, the embargo was never an effective protection because Canadian cattle by the thousand, and by the million, had in past years been slaughtered at the ports, and the hides, offal and manure distributed throughout the country. As Sir Robert Borden had said, there was much more reason for Canada placing an embargo on cattle from the United Kingdom than there ever was for this country placing an embargo on cattle from Canada. It was admitted that the consumers' demand for fresh-killed meat could, to a certain extent, be met by the landing of fat cattle and their immediate slaughter at the ports, but the consumers were entitled to the further advantage of cattle coming into the country to be "finished" and fed up to the same standard of quality as that of home-grown meat which at present was only available for those who had a long pocket. The recent depletion in the herds of the country, as shown by the returns of the Ministry of Agriculture, was further testimony to the necessity for removing the embargo. It had been stated that the various interests concerned were not agreed, but such an artificial atmosphere had been created round this subject that the

deputation wished to be informed what those interests were. Before the War, it was known that the Irish Party in Parliament had used their political influence to prevent the raising of the embargo. On the other hand, the Canadian authorities had stated that it was a matter of fiscal policy, and in this connection the Imperial aspect of the question could certainly not be overlooked. It was submitted that the only interests not fully agreed were either political interests or the interests of the British farmer, who, it was suggested, desired an immoderate return on his capital. Reference was made to the enhanced prices of both home-store cattle and home-killed meat, and it was urged that, if the embargo were continued and the Food Ministry's control of prices removed, the consumers would be in a serious position as between the farmers on the one hand and the Trust of meat importers on the other. The time had now come either for the Government to keep its promise made at the Imperial War Conference or to give some sound reason which would appeal to the intelligence and understanding of the general body of electors and citizens of this country.

Mr. Henderson, Canadian Cattle Association, referred to the statement that farmers were opposed to the removal of the embargo, and pointed out that farmers did not constitute more than 5 per cent. of the population. The only farmers who did not want Canadian cattle were those who had never handled them. The Scottish Farmers' Union and the Scottish Chamber of Agriculture were against the embargo; in fact, the only people who supported it were a few breeders, whose objection in Scotland on the grounds of disease seemed inconsistent with their action in importing cattle from England, where disease is known to exist at the present time. In the interest of food production, a supply of store cattle was necessary to fertilise the land; otherwise the production of cereals and potatoes must seriously diminish. It was probable that as many as 200,000 store cattle per annum would come in if the embargo were lifted. The situation would be met by the restoration to the Minister of a discretionary power to admit live animals from any part of the world.

Mr. Brown, Dunfermline Co-operative Society, on behalf of the distributive side of the Co-operative Movement, urged that the consumer did not want imported meat. The price of the home article, since decontrol, was, however, rising almost beyond the reach of many of the working classes. He

thoroughly agreed with what had been said by previous speakers, and hoped that the Government would see its way to remove an embargo which co-operatives considered was unjust to Canada.

Baillie Walker, representing the Glasgow Corporation, said that in that town there existed a great industrial population which was continually clamouring for home-grown meat, whereas 50 per cent. of the meat consumed was imported. A wharf had been built on modern lines for the reception of foreign animals, but the only animals which had as yet been landed there came from Ireland. If live cattle were admitted instead of frozen carcasses, not only would it reduce the cost of living but the valuable hides and offals would be available for the establishment of new industries in this country. In the interests of our great industrial masses, the embargo should be removed, even if the agricultural interest suffered to the exaggerated extent that was claimed.

Lord Lee, in reply, drew attention to the sharp difference of opinion which existed with regard to this important question. So far, however, as the representations which had reached the Ministry from responsible agricultural bodies were concerned, the agricultural interest of this country, at any rate of England and Wales, was overwhelmingly against the removal of the embargo. In any event, the matter did not rest within the executive discretion either of the Ministry of Agriculture or of the Government, as the removal of the embargo would require fresh legislation. In this connection and as an instance of the attitude of, at any rate, one House of Parliament, a private Bill was brought forward in the House of Lords last session, which proposed to deprive the Minister even of the very limited discretion at present conferred upon him by statute of admitting very exceptional animals of high pedigree value. Though opposed by the Government, the Bill was carried through the Upper House. This showed that the problem was not so simple as was represented, nor could the embargo be removed by a stroke of the pen. The Ministry had publicly endorsed the clean bill of health to which Canadian cattle were entitled, but Canada was not the only exporting country, and if legislation were proposed it would be impracticable to limit its operation to Canada alone. Primarily, of course, the Ministry had to regard this matter from the point of view of the interests of agriculture, but it was not oblivious to the other

important interests concerned. The interests of the community as a whole, and also the Imperial interests, had, of course, to be taken into consideration, and it was conceivable that, on balance, agricultural interests might in the last resort have to give way to some higher consideration. That, however, was a matter for the Cabinet and for Parliament. In any case, the Imperial aspect of the question would no doubt be fully discussed at the Imperial Conference this year.

The main argument advanced by the deputation seemed to have been that the removal of the embargo would result in a substantial increase in the supplies of fresh-killed meat. It had been suggested that as many as 200,000 stores a year might come in, though it was open to doubt whether so many would be available. Even if the whole of these beasts were used for fattening, and if they resulted in a net increase in the store cattle population of this country, they would represent but a minute fraction (less than 5 per cent.) of the total meat consumption of our population. In this connection, too little had been made of the fact that the ports were already open for the importation of Canadian or other cattle for immediate slaughter, and there were, apart from economic considerations, no limits or obstacles to the development of that trade, which would ensure for this country the hides and the offal to which reference had been made. With regard to the supply of home-grown stores, there had been recently not only a considerable reduction in the slaughtering of calves, but also a marked increase in the number reared, and the situation gave promise of an early return to normal, so far as the re-establishment and maintenance of our herds were concerned.

Returning to the question of disease, it was unfortunately true that England was at present afflicted with a number of outbreaks of foot-and-mouth disease, as to the origin of which there was no positive information, though many theories had been advanced. The Ministry had appointed a Committee, composed of eminent scientists, to concentrate on an effort to isolate and identify the virus, but such a baffling investigation was not likely to be completed in a short space of time. In the meantime, there was undoubtedly a real lack of confidence amongst stock owners in this country as to the risk of the infection of their herds, and if the embargo were removed the result would be to discourage home-breeding which was far more essential than importation, especially from the point of view of the milk supply. It was admitted that the present

infection did not come from Canada. On the other hand, the countries adjacent to us on the continent of Europe were infected with cattle disease to an unprecedented extent, and, bearing in mind the fact that any fresh legislation for removing the embargo could hardly be limited in its operation to the Dominion of Canada, it was not desirable to run the risk of fresh disease which the admission of store cattle would involve. One great protection which was enjoyed at present was the "moat" which surrounded these islands, and having that protection, which was conferred by Nature and confirmed by Act of Parliament, it would require a good deal more argument than had at present been advanced to justify any departure from the policy maintained under the existing law. At the same time, it was very desirable to keep an open mind on questions of this kind, particularly scientific questions, and in addition to referring the problems arising out of disease to a Scientific Committee, the question of the effect of the importation of store cattle on the general agricultural interests of this country was being referred, not only to the new Council of Agriculture for England, constituted under the Act of 1919, but also to the Agricultural Advisory Committee for England and Wales. Pending the official expression of the views of these responsible bodies, it was not desirable that the Minister should express any further opinion with regard to future policy, but at the present moment, and as at present advised, his view was that the time was not opportune for the introduction of the legislation that would be necessary to secure the end which the deputation had in view.

Mr. May, in thanking the Minister for receiving the deputation, said that the Minister's definite and detailed reply contained important points which would require the most careful consideration of the deputation before any further action were undertaken.

FOOT-AND-MOUTH DISEASE:

INTRODUCTION FROM ABROAD.

THE way by which foot-and-mouth disease is brought into Great Britain and similarly situated countries from time to time, notwithstanding the fact that into the former in particular the importation of susceptible live stock is prohibited, is as mysterious as it is interesting. The subject has given rise to spasmodic discussions, but the possibilities do not seem to have been methodically debated in relation to the actual facts, so far as they are known. The happenings from the beginning of 1919 have provided more material than in former years for a closer analysis of the subject. It is not claimed that the results bring finality to a question which for many years has baffled the best scientists in Europe, but it may be that by elimination they outline the direction to be followed in future inquiry.

It may be accepted as established that Great Britain freed from the disease in enzootic form is only invaded when the disease is prevalent on the Continent, particularly when it prevails in the north of France, Belgium and Holland. In the light of recent experience, it would also appear that the greater the prevalence, the more frequent are the invasions.

Live stock being excluded as a factor, it is not unnatural that suspicion should have fallen upon human beings coming from the Continent where the disease is raging, and on imported feeding stuffs and litter. It may be mentioned, however, to save further discussion, that the importation of hay and straw, except for exceptional purposes, has been prohibited since 1908, and that the position as regards foot-and-mouth disease has not apparently been modified in consequence.

Initial Outbreaks and Secondary Outbreaks.—For the purpose of analysis and discussion outbreaks of foot-and-mouth disease fall into two classes, initial outbreaks of invasion, and secondary outbreaks, which are local ramifications from the initially established centre. As regards the latter, investigation by the Ministry has seldom failed to establish satisfactorily the way by which disease has spread. Much useful information on this subject is available. It is with initial outbreaks of invasion, however, that this article is mainly concerned, and there have been 68 in the last 20 years. The term is applied to those outbreaks which arise after the country has been free from disease for more or less long periods, which are far in excess of what we have reason to believe represents

the viability of the virus inside or outside the bodies of animals—months or years, and to outbreaks occurring almost simultaneously in parts of the country very remote from each other—Surrey and Northumberland, for example—which have no possible connection with each other, except perhaps through the still mysterious agency whereby the virus travels long distances and in certain directions, this being apparently the same problem as that of invasion from without the country.

The above classification of outbreaks may at first sight appear somewhat artificial. It will be apparent that it is not so, however, if due consideration be given to the following facts:—

- (a) That there is often an excessively long interval of time between the outbreaks—months and even years.
- (b) That outbreaks may occur almost simultaneously at long distances from each other having no possible ordinary connection (feeding stuffs, men, &c.) with each other.
- (c) That for the last 20 years the policy of immediately slaughtering all affected animals and actual contacts before virus can be freely manufactured by them and disseminated, has been almost exclusively followed, together with complete disinfection of infected premises both by chemical agents and prolonged isolation.
- (d) That recurrences after re-stocking formerly infected premises with susceptible animals is practically unknown.
- (e) That the same premises are almost never hit twice, as it were, by invasions after more or less long intervals.
- (f) That the efficacy of the measures outlined in (c) would appear to be proved by (d) and (e).

In every outbreak it is customary for the Ministry's Inspectors to collect the fullest information possible regarding articles brought on to the place and their origin. Similarly, the recent movements of animals and human beings connected in any way with the premises are inquired into and recorded. Obviously, however, it is information of the kind in connection with initial outbreaks only which might throw light on the manner of invasion, and it is such information which has been utilised for the purposes of this article.

Whether Disease is communicated by Feeding Stuffs, Packing Materials and Human Beings.—These represent the communications between animals of the farm and the outside world, and it is not unnatural that they should have fallen under a sustained suspicion. The object of the inquiries which have been made over a period of years was to find whether any credible

factor repeated itself in a number of outbreaks, or whether any lines of evidence from a series of initial outbreaks would converge on one point, for example, on a cargo or consignment of feeding stuffs, &c. It may be said at once that it has not been possible to establish anything of the kind. It is true grave suspicion has sometimes rested on a certain article, mainly on account of its advent synchronising with the appearance of disease on the premises, but in almost every case further inquiry has shown that the same consignment has been distributed to many other premises where no disease has occurred. It is also correct that an occasional outbreak arose near camps in which soldiers from the Continent had been concentrated. On the other hand no actual communication was established between the soldiers and the premises which became infected. Moreover, initial outbreaks had been known to occur in the past in the same locality when there were no soldiers or other persons to suspect, and in the vast majority of cases no outbreaks arose near camps of the kind.

The most that can be said of the above evidence is that it is not in favour of the view that infection is generally brought to this country by men and such articles as have been mentioned, but in addition there is the fact that many initial outbreaks have occurred on premises far removed from others, the animals of which having received only foodstuffs grown on the place, and the attendants not having been off the place for weeks before disease appeared. The weightiest evidence, however, against men, foodstuffs, &c., being responsible for the importation of initial infection has arisen in the last year or so, during which the invasions have been exceptionally frequent. It will be shown later that invasions have repeated themselves during the last 20 years in more or less defined areas of the country, though not on the same premises, large parts of England and Wales, and the whole of Scotland and Ireland having escaped entirely or almost so (there has been one initial outbreak in Scotland, at Edinburgh, in the last 20 years). These immune areas receive the same class of foodstuffs, &c., and are visited by the same class of human beings, and it is almost inconceivable that over a period of 20 years certain areas could receive all the infected persons and things which came into the country, and others escape entirely, if persons and foodstuffs are generally responsible for the importation of infection. This is all the more remarkable when it is remembered that in over 80 per cent. of the outbreaks of anthrax, infection is conclusively shown to arise from imported

feeding stuffs and manures, and that the outbreaks follow the lines of distribution, sparing no parts of the part of the country in which they are used, Scotland for example, being as heavily hit in proportion as England.

If, then, the usual communications between the animals of the farm and the outer world do not account for the conveyance of something—virus of foot-and-mouth disease in this case—which arrives on farms with a certain amount of frequency, other possible methods of communication must be considered, even if they appear at first sight fanciful.

Distribution of Disease in Great Britain during the last 20 Years.—It has been previously stated in this article that certain parts of the country were hit, as it were, initially with much greater frequency than others, and that some habitually escaped altogether. The outbreaks have been examined over a period of 20 years, and a list of the initial ones, together with the exact dates and localities, has been compiled.

The counties in which two or more initial outbreaks have arisen in that period are as follows:—Bedford 3, Devon 2, Dorset 2, Durham 3, Essex 3, Hants 2, Kent 8, Lancaster 2, Lincoln 2, Northumberland 2, Somerset 5, Suffolk 2, Surrey 3, Sussex 5, Warwick 2, Wilts 3, Yorks (West Riding only) 4, Denbigh 2.

In the following counties initial outbreaks arose once in the same period:—Cambridge, Chester, Cumberland, Gloucester, Isle of Wight, Hertford, Leicester, Norfolk, Oxford, Stafford, Pembroke, Flint and Midlothian.

No initial outbreaks have arisen in:—Berkshire, Buckinghamshire, Cornwall, Derby, Herefordshire, Huntingdon, London, Middlesex, Monmouth, Northampton, Nottingham, Rutland, Shropshire, Westmorland, Worcester, Ridings of Yorkshire (except the West), or Isles of Scilly. None have arisen in Welsh counties except Pembroke and Flint, and none have arisen in Scotch counties except Midlothian.

From the above it will be seen that in the last 20 years about one-fifth of the counties of Great Britain were hit twice or oftener, the highest records being for Kent and the neighbouring county of Sussex, Somerset and the West Riding of Yorkshire; that in about one-eighth of the counties only one outbreak arose, and in the remainder there were no initial outbreaks. If, however, the counties are grouped according to locality, taking for example the area represented on the east and south by Sussex, Surrey, Hertfordshire, Bedford, Cambridge, Norfolk, Essex and

Kent, it will be seen that 27 (about 48 per cent.) of the 68 initial outbreaks in the last 20 years have appeared in this area. Taking the Southern section of the country represented by Hampshire, Dorset, Wiltshire, Somerset and Devon, 15 initial outbreaks (24 per cent.) have arisen there. In both groups there are areas, Cornwall and Middlesex for example, in which no such outbreaks have occurred. There are also small areas, for example a strip along the north coast of Wales in Carnarvon, Flint and Denbigh, where they have arisen at least often enough to be remarkable.

It does not seem likely from what has been said that the incidence of invasion in these areas can depend entirely on fortuitous circumstances, and it is possible that if the explanation of this incidence was forthcoming, it would also explain the method of invasion in general.

Air-borne Virus.—No support having been found for the ordinary methods of conveyance of virus, it seems justifiable to explore the possibility of the virus being air-borne for long distances, either by air currents or birds, or otherwise. As regards air currents, when affected cattle are allowed to remain alive on open pastures or at work, as is customary on the Continent for example, it is no uncommon thing to see strings of viscous slobber from the mouth whirled up into the air and dispersed into minute parts which disappear from sight. This material is known to be infective in infinitesimal doses, and it can therefore stand a high dilution. What becomes of it after it gets into the air is obviously a question which cannot be answered definitely. It is a fact, however, that even in this country where the official method of handling diseased animals—housing and almost immediate slaughter—gives few opportunities for virus to spread, ramifications in the direction of a strong prevailing wind have been occasionally observed to a distance of a few miles, and no ordinary communication could be traced by the minutest inquiry. Having regard to the distance which volcanic dust can be borne in the air it seems reasonable to believe that very small particles of infected mucus could be carried long distances by air currents, even in clouds, and be washed down in rain. The experiments of Blackley which showed that the air may be heavily charged with grass pollen, and that it might be carried thus as far as from Norway to this country, are of some interest, and it may be remarked that pollen from pastures in infected countries might be contaminated.

Accepting air-borne virus as possible, the next question which arises is, whether there exists more frequently anything in the

form of air pockets of negative pressure in the areas mostly invaded, which could account for the suspended virus descending to earth or water. These are problems which obviously should be discussed with those who are now exploring the air. As regards birds, it immediately suggests itself that if birds in general are responsible, there should be definite periods of invasion, given prevalence of disease in other countries, which synchronise with those of the migration of birds inwards. There are two migratory seasons, during both of which birds arrive in or leave this country. In the autumn certain birds leave to winter elsewhere. These can be disregarded as importers. Others arrive to winter in this country. These can probably be disregarded, as most of them come from the North where the disease seldom prevails. In the Spring months birds come in mainly from the South for breeding purposes, and might be carriers whilst others depart for the North.

In going back over the outbreaks in the period of 20 years, however, it appears that the lowest records of invasion are March—4, April —1, May—0; July, in which there is no migration, shows 8. September, October and November, when birds may be expected from the north and north-east, which are not the lands of prevalence as regards foot-and-mouth disease, show respectively 7, 7, and 4, while December, during which there is practically no migration inwards, shows 9.

These data are against the suggestion that there is any general relation between migration and invasion by foot-and-mouth disease. They do not, however, exclude the agency of those birds, such as ducks, geese and gulls, which may, outside the migratory seasons, travel long distances for food. For purposes of closer investigation it might be assumed:—(a) that such birds might in their travels frequent contaminated pastures or drinking places and afterwards deposit virus in this country from their feet or plumage; (b) That they might swallow infected material, such as water and food contaminated by slobber and pieces of membrane from the mouths of cattle, and afterwards excrete the virus in a still active state. It is hoped that experiments which are to be conducted on the viability of the virus may determine the possibilities as regards (a) and that as regards (b) feeding experiments with the virus, using birds, may at least show whether the virus can pass through their intestines unchanged, and render their excretions infective for lengthy periods.

As the matter stands at present, however, the evidence, such as it is, is most in favour of particles of virus being carried by the air.

THE MODERN COTTAGE OF CHALK AND CEMENT.

JOHN F. WILKES.

In the September issue of this *Journal* an article was published describing experiments in cottage building in pisé de terre which are being conducted by the Ministry on its farm settlement at Amesbury. Among the illustrations which accompanied the article was one showing a cottage of chalk and cement blocks (made in a block machine) in course of erection. The following account of cottages built of the same materials at Elmdon, near Saffron Walden, some years ago may be of interest.

The photographs here reproduced were all taken in 1920. It will be noticed how well the stability and good appearance of the cottages have been preserved.

Fig. 1 illustrates a pair of cottages erected in 1904. The ground floor is built of chalk cement blocks, and the upper floor of lath and plaster on stud work; the chimneys only are of brick. The total cost of the two cottages was £356 9s. 8d. They contain 13,000 cubic feet, and the estimated saving of cost by using chalk blocks instead of bricks for the ground floor walls was £14 for the pair.

Fig. 2 illustrates a single cottage built in 1907 on similar lines, at a cost of £166, excluding outbuildings or fencing. The builder's original estimate was £187 for a brick cottage, but a saving of £21 was effected in respect of haulage, bricklayers' time, and the lower cost of blocks as compared with bricks at the time.

Fig. 3 illustrates a bailiff's house built in 1909. It is made entirely of chalk cement blocks, except for the chimneys. Twenty tons of cement were used at a cost of 16s. 6d. a ton at works; the cost of labour in making the blocks was £16 15s. The total cost of the house was £388, including cost of haulage of cement and bricks.

Fig. 4 shows a granary built in 1920 of chalk cement blocks made in 1919. The cost of chalk and cement blocks has increased considerably since 1904, as will be seen from the following table. The costs stated do not include the value of the chalk.

It will be noticed that in 1904 blocks were slightly larger than in 1919, and that the proportion of chalk to cement was



FIG. 1.—Pair of Cottages erected in 1901. Ground Floor built of Chalk and Cement Blocks. First Floor of Lath and Plaster.



FIG. 2.—Single Cottage erected in 1907, built on similar lines to Fig. 1.



FIG. 3 —Bailiff's House erected in 1909, built entirely, with exception of chimneys of Chalk and Cement Blocks



FIG. 4.—Granary erected in 1920, built of Chalk and Cement Blocks made in 1919.

4 to 1 as against 5 to 1 in 1919. During the last twelve months the cost of both cement and labour has risen considerably, even over the figure for 1919, and the present prices are quite beyond what the writer can afford from the income of the estate. The making of these blocks in this locality has in consequence ceased. Chalk and cement have, however, been used in repairing cottages originally built of lime mortar plaster.

<i>Year.</i>	<i>Size of Blocks.</i>	<i>Construction Ratio.</i>		<i>Cement per ton at Works.</i>
		<i>Chalk</i>	<i>Cement.</i>	
1904	18 in × 9 in. × 6 in	4	1	25s. 6d.
1907	18 in × 9 in × 6 in.	4	1	16s. 6d.
1919	18 in × 9 in. × 5½ in.	5	1	67s. 0d.

	<i>Haulage 14 Miles.</i>	<i>Total Cost per Ton.</i>
1904	5s. 6d	31s 0d
1907 ..	5s. 6d.	22s. 0d.
1919	12s. 0d.	79s. 0d

	<i>Labour per 100 Blocks</i>	<i>Cost of Cement per 100 Blocks</i>	<i>Total Cost per 100.</i>
1904	12s. 6d.	17s. 1d	29s. 7d
1907 ..	—	12s 6d	—
1919	21s 0d.	39s 6d	60s 6d.

Fig. 5 shows a cottage in which the original plaster has been entirely taken away at the ends, both inside and out, and rebuilt with chalk and cement without the use of any other material, such as hair or lime. This alteration was made in 1920. Previous work done on these lines has been found to answer well.

The blocks can be made by unskilled labour. The only material required in the way of plant is a few floor boards clamped together with wooden clamps, and wood partitions of the size of the end of the blocks. The process of manufacture is extremely simple. Chalk is run through a 1-inch sieve and mixed in a heap with cement and a little water. The whole is then well stirred with a shovel, and the mixture, in its damp state, is placed in moulds, and floated off with a trowel. When the mixture has set sufficiently, the clamps are taken off the moulds, and the blocks are then packed up to dry out. The drying takes about two or three weeks. The amount of water which should be added to the chalk and cement before the mixture is placed in moulds can be accurately gauged after a little experience. The mixture should be in a pliable state; if too much water is added, it takes longer to dry off, but otherwise no harm is done.

The blocks have always been made quite in the open. During frosty weather it is necessary to suspend operations, as the

water in the mixture would freeze, but wet weather is not harmful. The work is not heavy, and might suitably be performed by partly disabled ex-service men in districts where chalk is available. Such jobs could very easily be put out by piece work.

NOTE.—Mr. Wilkes' statement of comparative costs for blocks in the years 1904, 1907 and 1919 is very useful; but it should be noted that his proportions in the last year were 5 of chalk to 1 of cement, whereas for the chalk concrete block cottage at the Ministry's Farm Settlement at Amesbury the proportions were 12 of chalk to 1 of cement, or less than half the quantity of cement. The Amesbury Cottage, of which an illustration in course of construction was given in our September issue, and which is here shown completed (Fig. 6), has proved most satisfactory. Prices of both labour and cement have, however, risen since 1919. Mr. Wilkes used, roughly, $3/5$ of a ton of cement in the proportion of 5 of chalk to 1 of cement to produce 100 blocks equivalent in size to 800 bricks. In the proportion of 12 to 1, as at Amesbury, 240 blocks would be produced with the same quantity of cement, equivalent to 1,920 bricks. Taking the present price of cement at 107s. 6d. per ton and the labour at 25s. per 100 bricks, the cement used would cost £8 4s. 6d., plus labour £3. to make 240 blocks. This works out approximately at an equivalent in bricks of £3 5s. 0d. per 1,000 as against a present average price for bricks of £5 per 1,000

The other method of using chalk, adopted by the Department of Scientific and Industrial Research for one of their cottages at Amesbury, consisted of a mixture of chalk and cement in the proportion of 20 parts of chalk to 1 of cement. The mixture was lightly rammed between shutters, and has made excellent walling.



FIG. 5.—Cottage reputed outside and inside entirely with Chalk and Cement without the aid of Hair or Lime



FIG. 6.—Cottage on the Ministry's Estate at Amesbury built of Chalk and Cement Blocks

PREVENTION OF "BUNT" IN WHEAT.

E. S. SALMON and H. WORMALD,

*Mycological Department, South Eastern Agricultural College,
Wye, Kent.*

Introductory.—The disease of Wheat known as "Bunt" or "Stinking Smut," which is caused by the fungus *Tilletia tritici*, is too well known to farmers in this country to need a detailed description here.* In order to understand, however, how it is that preventive measures, consisting of treating the seed wheat with certain chemicals, protect the ensuing crop from "bunt," it is necessary to point out that the *spores* (minute seed-like bodies) of the fungus are commonly found adhering to the surface of the grain at the time of sowing. Unless these *spores* are killed by treating the seed with some substance poisonous to the fungus, the wheat seedlings are attacked soon after germination and infected by the fungus. The "spawn" (*mycelium*) of the fungus grows up within the tissues of the stem and finally, as the wheat comes into ear, destroys the substance of the young wheat grain, replacing it by the foul-smelling black mass of *spores* so familiar to the farmer.

In the season of 1918 an exceptionally severe outbreak of "bunt" occurred in a field of wheat on one of the farms of the South Eastern Agricultural College, Wye, Kent. The variety was "Red Standard;" the seed had been home-saved and had not been treated before sowing in the autumn of 1917. The field was 82 acres in extent; half of it (marked A in the plan on p. 1014) had been sown four weeks earlier than the other half, B, the respective dates being 20th October and 15th November. In the case of A, the seed was sown with the drill at the rate of $3\frac{1}{2}$ bushels to the acre, and in B the seed was sown broadcast at the rate of $3\frac{1}{2}$ bushels to the acre.

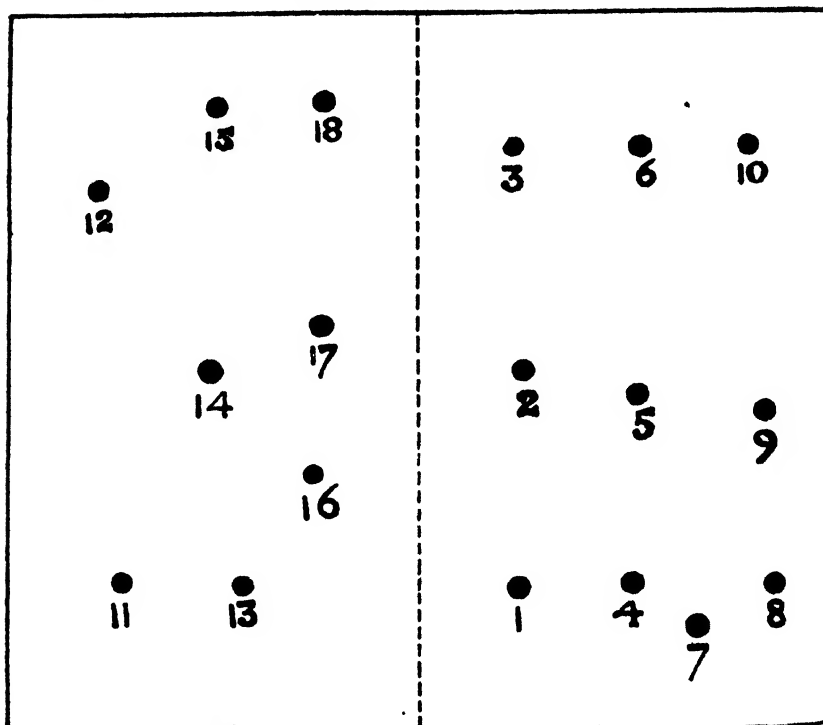
The crop in the part A was ripe, and was cut and "stooked" eight days before the crop in B was ready to cut. As the field was cut, the crop, which had been observed to be badly attacked by "bunt," was sampled in the following way. At the places indicated in the plan a whole sheaf was taken, and the ears of wheat examined one by one and the number counted of healthy

* An illustrated Leaflet (No. 92) on Bunt, giving the full life-history, can be obtained post-free on application to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W. 1.

and of "bunted" ears.* The following table shows the results obtained:—

Table showing percentage of "Bunted" ears in a 32-acre field of Red Standard Wheat, Wye College Farm, 1918.

<i>Position in Field.</i>	<i>No. of Healthy Ears in the Sheaf.</i>	<i>Ears in the Sheaf.</i>	<i>"Bunted" Ears.</i>
1	1,380	375	21.4
2	1,180	107	8.3
3	753	77	9.3
4	1,080	150	12.2
5	1,265	212	14.4
6	1,330	127	8.8
7	1,405	275	16.4
8	1,290	160	11.0
9	1,694	132	7.2
10	1,095	252	18.7
11	1,520	25	1.6
12	1,385	40	2.8
13	1,294	6	0.5
14	1,230	23	1.8
15	1,216	20	1.6
16	1,428	17	1.2
17	1,287	16	1.2
18	1,007	43	4.1



Plan of Field: Showing positions from which sheaves were taken.

*Mr. P. K. Dey, M.Sc. (who was then working in the Mycological Laboratory at Wye College) carried out this work, and the authors of the present paper wish to express their thanks to him for the help given.

It will be seen from the table that the severity of the attack of " bunt " in part A of the field varied from 7.2 per cent. to 21.4 per cent.—an average of 12.8 per cent., and in part B of the field from 0.5 per cent. to 4.1 per cent.—an average of 1.8 per cent. The cultivation and manuring of both parts of the field had been the same for the wheat crop, though the cropping had been different in 1917.* It would appear, therefore, that the greater severity of attack in part A of the field was due to some circumstances favourable for infection. Other cases are on record where wheat sown earlier in the autumn has been less severely attacked than similar seed sown later.

This severe natural outbreak of " bunt " provided us with excellent material for producing artificially severe outbreaks of " bunt " for experimental purposes. The " bunted " grains collected from the crop in 1918 were broken up and mixed with a certain amount of healthy seed from the same crop. After this admixture, the seed, as seen by the naked eye, was more or less discoloured, the end of the grain which bears a tuft of hairs being noticeably darkened. On microscopical examination, it could be seen that this discoloration was due to myriads of the " bunt " *spores* adhering to the surface of the grain, the tuft of hairs often being clogged with a dark mass of *spores*. Such artificially contaminated seed was used in the Field Experiments carried out in 1919 and 1920 which are described below. As will be seen, this seed, when sown without being treated, produced a crop very severely affected with " bunt," while treatment of the seed with certain substances killed the " bunt " *spores* adhering to the seed, which consequently produced a healthy crop.

Methods of Treating Wheat Seed.—The practice of treating wheat seed with a solution of copper sulphate (Bluestone)—an operation often called " pickling "—has been commonly adopted by farmers in this country for many years. The strength of the solution advocated for this purpose varies from one per cent. (1 lb. copper sulphate to 10 gal. water) to ten per cent. (10 lb. to 10 gal. water) and 1 gal. of the solution is used to the sack of wheat. In the writers' opinion, the solution used at this rate is insufficient to wet all the grains (clevils).

In the autumn of 1920 a sample of wheat (variety " Red Standard ") which had been pickled by a farmer in Kent with a 10 per cent. solution of copper sulphate, using 1 gal. to the sack, was sent together with an untreated sample of the same seed

* A had been cropped with potatoes, and B half with clover and half with sainfoin.

to the Ministry's Seed Testing Station for germination tests. The untreated sample germinated 98 per cent. in four days. The treated sample germinated only 47 per cent. in ten days; after 15 days it gave 57 per cent. and finally reached 60 per cent.

The extremely injurious effects, viz., the killing of a considerable percentage of the seeds and general retardation of the germination which is caused by a 10 per cent. solution of copper sulphate makes the latter, in the authors' opinion, far too dangerous a remedy for use against " bunt." This strength of solution, however, is at present commonly employed in England.* It is to be feared that many cases of a " poor plant " in wheat may have been caused by the seed having been " pickled " with too strong a solution of copper sulphate.

In preliminary germination tests carried out at Wye College it was found that a 10 per cent. solution of copper sulphate sprinkled over seed wheat so as to wet all the grains, reduced the vitality of the seeds to such an extent as to render the treatment impracticable. Solutions containing copper sulphate at concentrations of 5 per cent., 3.5 per cent., and 2.5 per cent. were then tried, samples being sent to the Ministry's Seed Testing Station for germination tests. The report received was as follows:—

<i>Method of Treatment.</i>	<i>Percentage of Germination</i>
5 per cent. copper sulphate	80
3.5 " " " "	86
2.5 " " " "	88
Untreated	95

It was finally decided not to employ copper sulphate at a concentration higher than 2.5 per cent. in the experiments described below.

Another chemical substance, however, viz., formalin† possesses equally fungicidal properties against " bunt," and it is the object of this article to show that this substance, not at present used by farmers in this country for the prevention of " bunt," is well worthy of trial, since in the two years' field experiments described below, its use has been attended with satisfactory results.‡

* e.g., in Kent, Sussex, Surrey, Berkshire and Herts.

† Formalin is the trade name for a 40 per cent. solution of the gas formaldehyde in water.

‡ In an article on the prevention of " Covered Smut " of barley (see this *Journal*, March, 1918, XXIV) the writers have shown that treatment of the seed with formalin gives complete protection against this disease, while the result of treatment with a 2.5 per cent. solution of copper sulphate was much inferior.

Field Experiments in 1919.—The seed used in these experiments was obtained from the crop of " Red Standard " wheat found to be severely attacked by " bunt " during the summer of 1918 (see p. 1013). Four samples of this wheat were taken; one sample was left untreated for the control plots and the others treated as follows :—

(1) *One per cent. Solution of Copper Sulphate.*—Commercial copper sulphate (98-99 per cent. purity) was dissolved in water,* so as to make a one per cent. solution (*i.e.*, at the rate of 1 lb. to 10 gal.) which was sprinkled over the seed and well stirred in until all the grains were wetted; the seed was then spread out to dry.

It was found that the volume of solution necessary to wet the grains thoroughly was 1 part to 16 parts of the seed, *i.e.*, at the rate of 1 gal. of the solution to 2 bush. of the wheat, and the solutions used in all the experiments described below have been applied at this rate.

(2) *Two and a half per cent. Copper Sulphate.*—This solution, prepared at the rate of 2½ lb. copper sulphate in 10 gal. of water was applied in the same manner as the one per cent. solution.

(3) *Formalin 1 : 240.*—One part of formalin (40 per cent. formaldehyde) was added to 240 parts of water (*i.e.*, at the rate of 1 pint to 30 gal., or, for small quantities, 1 fluid oz. to 1½ gal.) and stirred in until the formalin was uniformly distributed. The solution was then applied in the same manner as the copper sulphate solution, but instead of immediately spreading out the wetted corn to dry, it was placed in a heap and covered over with sacking which had been soaked in formalin solution of the same strength as that sprinkled over the corn. After four hours the wheat was uncovered and spread out to dry.

The seed was treated on 16th November, 1918. dried overnight, and on the following day the four samples were sown broadcast at the rate of about 3½ bushels to the acre, on duplicated plots, each measuring 40 ft. by 10 ft. The plots were numbered as follows :—

Plots 1 and 5	seed treated with 1	per cent. copper sulphate.
" 2 " 6	" " "	2.5 " " "
" 3 " 7	" " "	formalin 1:240.
" 4 " 8	" "	untreated.

Samples of the treated and untreated seed were sent to the Seed Testing Station in order to have determined the effect of

* In dissolving copper sulphate in water, a wooden or earthenware receptacle must be used, not metal.

the treatment on the vitality of the seed. The report received was as follows :—

	<i>Method of Treatment.</i>	<i>Percentage of Germination.</i>
Sample 1	1 per cent. copper sulphate	94
" 2	2.5 " " "	86
" 3	Formalin 1:240	87
" 4	Untreated	96

In August, 1919, plants were pulled from the centre of each plot, tied into a bundle and labelled according to the plot from which it was taken. From each bundle 100 ears were cut off at random; these were carefully examined and the " bunted " ears separated from the sound ones and counted. The results were so striking that it was decided to make duplicate countings for confirmation, so another bundle of plants was pulled from each plot, the plants in this instance being taken from the ends of the plots.

The results of the two series of countings were as follows :—

<i>No of Plot.</i>	<i>Seed Treatment.</i>	<i>Number of Bunted Ears in 100.</i>	
		<i>From Centre of Plots.</i>	<i>From Ends of Plots.</i>
1	1 per cent. copper sulphate	17	15
2	2.5 " " "	3	1
3	Formalin 1:240	0	0
4	Untreated	49	71
5	1 per cent. copper sulphate	16	6
6	2.5 " " "	4	0
7	Formalin 1:240	0	0
8	Untreated	55	55

Combining these results for an estimate of the percentage of bunted ears according to the treatment the seed received. we obtain :—

<i>Method of Treatment.</i>	<i>Plot.</i>	<i>No of Bunted Ears in 200.</i>	<i>No. of Bunted Ears in 400.</i>	<i>Percentage Bunted.</i>
Copper sulphate 1 per cent.	1	32 }	54	13.5
" " " "	5	22 }		
Copper sulphate 2.5 per cent.	2	4 }	8	2.0
" " " "	6	4 }		
Formalin 1:240	3	0 }	0	0
" "	7	0 }		
Untreated	4	120 }	230	57.5
"	8	110 }		

Field Experiments in 1920.—In the following season another experiment was carried out in order to ascertain whether the results obtained in 1919 were confirmed by further trials, and also to determine whether a lower concentration of formalin

would be equally effective with the one already employed. For this experiment the seed from the plots grown in 1919 was collected and thoroughly mixed. Samples were taken and treated as in the previous season, together with a fifth sample that was treated with formalin at a concentration of 1 part in 820 parts of water (i.e., at the rate of one pint to 40 gal. of water). Ten plots each 80 ft. by 14 ft. were marked out for the experiment so that each sample could be sown on duplicated plots.

As the total quantity of corn from the plots grown in 1919 was not great the threshing had been done by hand, and in consequence many of the " bunted " grains remained unbroken. These " bunted " grains were not separated out. The success of the sprinkling method of treatment as shown in the results given below, calls for remark since it is generally assumed that when such unbroken " bunted " grains are present in the corn, submersion of the seed in the fungicidal solution is necessary in order that the diseased grains may float to the surface and be skimmed off.

At the time of sowing, samples of the treated and untreated seed were again sent to the Seed Testing Station and the following report on germination was received:—

	<i>Method of Treatment.</i>	<i>Percentage of Germination.</i>
Sample 1	1 per cent. copper sulphate	96
" 2	2.5 " " "	82
" 3	Formalin 1 : 240	86
" 4	" 1 : 320	88
" 5	Untreated	92

When the seedling wheat plants were a few inches high some difference in the vigour of the plants of the various plots could be detected, and in February, 1920. Mr. J. H. Mattinson examined the plots and reported on their condition (without knowing the history), as follows:—

Normal forward crop: best plant . . Plot 5 (One of the two control plots).

A thin rather weak plant Plots 3 and 8 (formalin 1 : 240).

The crops of the other plots were intermediate between the above and practically indistinguishable except Plot 9 (formalin 1 : 820) which though slightly better than Plots 3 and 8 was not so good as the rest.

These observations suggest that the formalin treatment has an adverse influence on the vigour of the seedling wheat plants, but further observations are necessary before definite conclusions

can be drawn on this point.* As the plants approached maturity the difference was not maintained, and when harvested the crops were equally vigorous apart from the plants infected with " bunt."

In August, 1920, bundles of plants were pulled from each plot and the number of " bunted " ears determined as in the previous year. Five bundles, however, were taken from each plot so that for each method of treatment 1,000 ears were examined. The results are shown in the table :—

Plot.	Method of Treatment.	No. of Bunted Ears in 500.	No. of Bunted Ears in 1000.	Percentage Bunted.
1	Copper sulphate 1 per cent	29 }	71	7.1
6	" " " "	42 }		
2	Copper sulphate 2.5 per cent	12 }	22	2.2
7	" " " "	10 }		
3	Formalin 1:240	0 }	2	0.2
8	" " " "	2 }		
4	Formalin 1:320	0 }	1	0.1
9	" " " "	1 }		
5	Untreated	117 }	319	31.9
10	"	202 }		

The only precautionary measures adopted at the time of sowing to prevent re-infection of the treated seed by spores from the untreated seed, consisted in sowing the former and raking it in before the latter was sown. Considering the fact that all the plots were sown on the same morning, and that the two formalin plots in which 1 and 2 " bunted " ears, respectively, were found, adjoined the control plots, the extremely low number of cases of infection on the formalin plots is remarkable. The results obtained show that the formalin treatment as employed in these experiments is completely effective in controlling " bunt " in wheat.

As the formalin treatment is not generally practised in this country the following notes on its use, based on the experiments recorded above, may be useful :—

(1) The diluted solution recommended for use is prepared by adding one part of formalin (40 per cent. formaldehyde) to 320 parts of water (*e.g.*, one pint formalin to 40 gal. of water, or, for small quantities, 1 fluid oz. to 2 gal.).

(2) This is slowly sprinkled over the seed wheat at the rate of 1 gal. of solution to 2 bushels of seed; the seed is moved about and stirred until the grains are thoroughly wetted.†

(3) The seed is then placed in a heap and covered with sacks

* Field Trials using formalin at lower concentrations are in progress.

† Under no circumstances must the solution be allowed to form pools under the heap in which grains might soak.

which have been soaked in the formalin solution; the sacks should be uniformly wet but not dripping.

(4) The treated seed is left covered up for 4 hours, then spread out to dry on a clean floor; if the floor has been previously used for untreated corn it should be wetted all over with the formalin solution and allowed to dry before the treated seed is spread on it.

(5) Precautions should be taken to prevent the re-infection of the treated seed, *e.g.*, sacks which have held untreated infected wheat should not be used for the treated seed, unless they have undergone treatment by being soaked in the formalin solution or boiled in water.

Summary.—1. There is reason to believe that the common practice of " pickling " seed wheat with a 10 per cent. solution of copper sulphate (1 lb. to 1 gal. water, as a preventive against " bunt " results in serious damage to the germination of the seed.*

2. Experiments carried out at Wye College on wheat of the " Red Standard " variety grown on duplicate plots during two seasons have shown that:—

(a) Formalin 1 : 240 solution or 1 pint to 30 gal. water, when sprinkled over the seed, which is then covered by sacks soaked in the same solution for 4 hours before being spread out to dry, completely controls " bunt " in wheat.

(b) A 2.5 per cent. solution of copper sulphate (2½ lb. to 10 gal. water) reduces the amount of infection considerably but is less effective than the formalin solution.

(c) A 1 per cent. solution of copper sulphate (1 lb. copper sulphate to 10 gal. water) also reduces the amount of infection, but is far less effective than either the formalin solution or the 2.5 per cent. solution of copper sulphate.

3. Formalin, 1 : 320 solution or 1 pint to 40 gal. water, has proved to be as effective in controlling the disease as the stronger (1 : 240) solution, and is therefore to be preferred.

4. The quantity of solution necessary to wet thoroughly 4 bushels (a sack) of wheat has been found to be 2 gal.

5. The formalin solutions at the above strengths and also the 2.5 per cent. solution of copper sulphate show a tendency to reduce slightly the percentage of germinating seeds, so that treated seed should be sown a little thicker than normal.

* For this reason the Ministry of Agriculture in its Leaflet No. 92 recommend a weaker solution even though it is known that with this solution the control of bunt is not so complete.—*Editor Journal.*

RECENT RESEARCH IN EGG PRODUCTION.

J. HAMMOND, M.A.,

School of Agriculture, Cambridge.

THE following account aims at giving, in a summarized form, a description of some of the results obtained by research work in egg production. Abroad, especially in America, a considerable amount of work has been done and much more is in progress. The results of this research work are often applicable to animal production in this country, and the short summary here given of some of the conclusions arrived at may therefore be of interest to those concerned in production.

Much of the research work which is alluded to below needs confirmation, as some of the experiments have only been carried out on a small scale, and many of the facts elucidated in other countries require investigation here before it can be definitely ascertained whether they hold good in our climate. A large number, however, are of universal application, and some of the discoveries mentioned below, such as the mode of inheritance of high egg production, have already been taken advantage of in this country.

Inheritance of High Production.—Extensive investigations have been made in the United States by Raymond Pearl⁽¹⁾ and other workers on the production of eggs, and many useful discoveries have been made. Probably the most important is that the power of high production of eggs in the hen is inherited mainly through the cock. Pullets that are bred from a cock of high-producing strain mated with hens of a moderate-producing strain will lay many more eggs than will pullets which have been bred from a cock of moderate-producing strain mated with hens of a high-producing strain. Pearl's investigations were made with the Plymouth Rock and Cornish Indian Game breeds, and in view of their great importance it is desirable that they should be repeated with the breeds and strains of fowls kept in England. Indeed, it seems of the utmost importance, if any advance is to be made in the average yield of eggs, that the inheritance of fecundity in English breeds should be tested. Goodale⁽²⁾ found that in the Rhode Island Red high egg production was inherited, but not in the manner observed by

(1) *Jour. Exp. Zoology*, 1912, p. 153.

(2) *Jour. Agr. Res.*, Vol. 12, 1918, No. 9.

Pearl. Pearl found also that the difference between a high-producing and a low-producing hen did not depend on the number of oocytes in the ovary, but on the number which developed, and that this quality was inherited in the fowl. He further discovered that the best measure of the capacity of a hen to produce eggs was the number of eggs produced during the winter months; hens which laid well at that time produced the greatest number of eggs in the year.

Selection of Hens.—Several investigators have given attention to the problem of the early identification of a high-producing hen, so that the unproductive layers may be weeded out with a minimum of delay. Blakslee and Warner⁽³⁾ found that when birds with yellow pigmented skin, ear-lobes, beak and legs (as in Leghorns, Plymouth Rocks and Wyandottes), begin to lay, the yellow colour disappears from the ear-lobes, beak and vent, in the order named, probably being transferred to the yolk of the egg. When laying stops the colour is regained in the same order. This result was taken as a test for the unproductive hen, and it is found that the greater the amount of yellow colour in the ear-lobe the less active is the laying.

Chard⁽⁴⁾ has found that the high producers of one year continue to be the high producers during the second year, and that all the birds selected for high production during the months of November, December and January gave high records for the whole year.

Ball and Alder^(4a) also found that the more eggs hens produced in the year the greater was the proportion laid during the winter period; so that the breeding and keeping of hens of high productivity has the double advantage, in that not only are more eggs produced, but that they are produced at a time of scarcity and so command good prices. Wilson⁽⁵⁾ has discovered that a hen's total yield for the year can be predicted from her performance during the first eight or ten weeks of the laying season (November, December and January). Good layers produce during this period as many as five eggs per week, while bad hens yield few, if any.

Chard⁽⁴⁾ also noticed that the production of eggs was closely dependent on the temperature, and this is probably the underlying cause of the variations in productivity that exist at

(3) *Utah Sta. Bul.*, 1917.

(4) *Connecticut Storrs Sta. Bul.*, 1917.

(4a) *Jour. Amer. Assn. Instr. and Invest. Poultry Husbandry*, No. 5, 1917.

(5) *Jour. Dept. Agr. and Tech. Instn. for Ireland*, Vol. 14, p. 271.

different times of the year. The causes of these variations require to be carefully analysed. Temperature may be only one of the factors influencing this point; there may be others, such as differences of light and darkness, or the amount of green food available, which cause increased production during the spring months.

Research is required as to the effect of a rise of temperature on the egg production of fowls which have become used to a low temperature, to determine whether it is the change of temperature or the actual temperature which causes increased production of eggs in the spring months.

Variation with Time of Year.—Numerous investigators have recorded the variations in productivity that occur as a result of the time of year. The following table summarizes some of the results obtained :—

Average Egg Yield per Bird per Month.

Authority.	Jan	Feb	Mar	Apr	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.
Pearl (*) (U.S.A.)	11.71	10.47	16.11	15.86	13.92	12.46	10.87	9.84	*	*	4.63	8.91
Buckley (7) (England)	5.50	7.91	11.97	13.23	12.90	9.70	8.01	6.33	5.29	3.70	3.60	5.46
Irish Egg Record- (7a)	6.3	9.3	15.9	15.8	14.9	11.5	10.1	8.3	6.0	3.9	2.4	4.0

* No data

Simpson⁽⁸⁾ in Edinburgh found that the highest egg production took place in April and May. Data collected by the author of this paper show that in Norfolk the highest production is reached in March and April. This monthly variation in production is probably due to variations in temperature, as in Australia⁽⁹⁾ the highest egg production is reached in the months of September and October, which correspond to our months of March and April.

Economically this monthly variation in production is important, as it governs the price of eggs, which bears an inverse ratio to the number produced. The curve of the rise and fall in price follows and lags slightly behind the curve of production.⁽¹⁰⁾ It follows that the most successful poultry keeper is

(6) *The Canadian Thresherman and Farmer*, Vol. XX., No. 2, 1915.

(7) *"Farm Records and the Production of Clean Milk at Mounslmere,"* London, 1917.

(7a) *Dept. Agr. and Tech. Instr. for Ireland*, Vol. 13, p. 366.

(8) *Proc. Roy. Soc. of Edinburgh*, Feb., 1912.

(9) *Queensland Agricultural Journal*, N.S. Vol. I., 1915.

(10) *Maine Sta. Bul.* 105, 1908.

he who manages his flock so as to produce eggs when they are scarce. In this connection it may be emphasised that the high-producing hen lays a greater proportion of eggs at those times when eggs are scarce.

Attempts have been made to modify this variation in production due to time of year by obtaining pullets hatched at certain seasons of the year.

Elford⁽¹¹⁾ in Canada found that, in both Leghorns and Plymouth Rocks, early hatched pullets laid the most eggs in the year, and consequently a greater proportion in the months when eggs were scarce. Buckley⁽⁷⁾ in England, who experimented with several breeds, obtained the following results:—

	February Pullets.	March Pullets.	April Pullets.	May Pullets.	Hens of previous Year.
No. of eggs laid between October and March ..	64	62	48	39	39

Buss⁽¹²⁾ in America found that White Leghorn pullets hatched in different months of the year produced the following average number of eggs per annum:—

February hatched.	April hatched.	June hatched.
167.	156.	144

Variation with Age of Hen.—Buckley⁽⁷⁾ found that hens did not produce so well as pullets which had been hatched in time. Ball, Alder and Egbert⁽¹³⁾ have studied this point in a flock of White Leghorns over a period of eight years; the average egg production per hen for each year of life from their investigations was as follows:—

Years of Life.	1	2	3	4	5	6	7	8
No. of eggs laid per year (approximately)	130	121	110	85	75	65	55	45

In the Copenhagen⁽¹⁴⁾ egg-laying trials it was found that the older hens, as compared with the younger, lay a smaller percentage of their eggs during the winter months, when eggs are most valuable.

Rhythm of Egg Production.—It has been noticed by several investigators that egg-laying takes place in cycles (i.e., periods of consecutive egg-laying at the rate of one egg per day) and

(11) *Canada Expt. Farms Rept.*, 1915.

(12) *Monthly Bul. Ohio Sta.*, No. 3, 1919.

(13) *Utah Sta. Bul.*, 1916.

(14) *84th Rept. Royal Vet. and Agri. Coll., Copenhagen*, 1914.

that there is a definite rhythm in the recurrence of these cycles.

Patterson⁽¹⁵⁾, who investigated this rhythm, has attempted to apply it to the selection of the highest producing hens. He found that hens which had a cycle of 4 eggs or more in March produced on the average 156 eggs per year, whereas hens having a cycle of 2 eggs or less averaged only 110 eggs in the year.

It is interesting to note that Atwood and Weakley⁽¹⁶⁾ discovered that the first egg laid in the cycle is usually the heaviest, and that the eggs decrease in weight until the cycle has ended.

Broodiness.—A probable cause of the lowering of the productivity is the onset of broodiness. This is largely a breed characteristic. Kirkpatrick and Card⁽¹⁷⁾, who investigated this point, found that the percentage of broody hens in the various breeds was as follows:—

White Leghorn, 9.7 per cent.; Rhode Island Reds, 65.6 per cent.; and Wyandottes, 69.6 per cent. They calculated that the average number of days lost by each broody hen in the year was 53.

Goodale⁽¹⁸⁾ estimated that broodiness reduces a hen's production by about 40 per cent.

In this connection it is suggestive that Pearl and Boring⁽¹⁹⁾ have discovered in the ovaries of fowls certain bodies which they consider resemble the *corpora lutea* of mammals.

Pearl and Surface⁽²⁰⁾ found that they could inhibit egg-laying in a fowl by giving doses of the *corpora lutea* of cows. These authors, however, disagree with Clark⁽²¹⁾, who claimed to increase the egg production of fowls by administering pituitary substance with the feed.

In the Copenhagen⁽¹⁴⁾ laying trials it was noticed that within any one breed broodiness was more pronounced in the best layers. As this result appears to conflict with the investigations of Goodale and the fact that "sitting" breeds are frequently better winter layers, it would appear that further research is required as to the effect of broodiness on egg production. It may be that some relation may exist between

(15) *Jour. Amer. Ass. Instr. and Invest. Poultry Husbandry*, Nos. 2 and 3, 1916.

(16) *West Virginia Sta. Bul.*, 1917.

(17) *Connecticut Storrs Sta. Bul.*, 1917.

(18) *Massachusetts Sta. Rept.*, 1915.

(19) *Amer. Jour. of Anatomy*, No. 1, 1918.

(20) *Jour. Biol. Chemistry*, No. 2, 1914.

(21) *Jour. Biol. Chemistry*, No. 3, 1915.

broodiness and the period occupied in moulting, but on these points, so far as the writer is aware, no research has been made.

Goodale⁽²²⁾ has shown that individuals of a breed show considerable variation in broodiness, and that the tendency to go broody increases with age. Broodiness is also dependant on the time of year and the temperature, but no effective methods of preventing it have yet been found.

Research on the effect of broodiness on egg yield and the physiological causes of the broody condition would appear to afford promising results.

Breed Variation.—Numerous breed trials and tests have taken place in most countries, but only a few need be quoted here.

Three-year tests made at Copenhagen⁽¹⁴⁾ show the following order of merit of breeds as regards production of eggs:—Leghorns 100, Plymouth Rocks 70, White Wyandottes 60

Lewis⁽²³⁾ quotes tests in the United States to show that the average number of eggs laid per bird per year was approximately as follows:—Leghorns 170, Plymouth Rocks 155, Rhode Island Reds 150, Wyandottes 144.

Laurie⁽²⁴⁾ in South Australia found that the average yearly egg production per bird in the various breeds was as follows:—White Leghorn 199, Orpingtons 170, Wyandottes 170.

It is possible, however, that English strains of these breeds would not hold the same relative positions as regards fecundity.

The Irish winter egg record tests⁽²⁵⁾ (October to March) for the seven years 1908-1915 show the following averages for the different breeds:—White Leghorns 49.5, Rhode Island Reds 45.9, White Wyandottes 35.8, Plymouth Rocks 32.9.

These records also show, however, that there is much greater variation in the different strains of a breed than there is between breeds; thus the best pen of White Leghorns averaged (October to March) 84 eggs, while the worst averaged 31 eggs, and the best pen of Plymouth Rocks averaged 55 eggs, while the worst averaged only 15 eggs. Within any breed there appears to be much room for improvement along the lines of inheritance of high egg production through the cock, as has been demonstrated by Pearl.⁽¹⁾

Ball and Alder^(4a) have shown that breeds differ in the time of year at which the highest rate of egg production takes place.

(22) *Anat. Rec.*, No. 6, 1917.

(23) *New Jersey Sta., Hints to Poultrymen*, No. 4, 1918.

(24) *Bul. Int. Inst. Agr., Rome*, II., 1914, p. 1400.

(25) *Dept. Agr. and Tech. Instr. for Ireland*, Vol. 15, No. 3, 1914-1915, p. 582.

They compared White-Leghorns with general purposes breeds, and found that the latter reached their maximum rate of production early in the season and then rapidly fell off to moderate production, whereas the White Leghorns reached their maximum production a month or so later, but continued to produce heavily for several months, and then fell off rapidly towards the end. Experiments in this country are required before these conclusions can be accepted as applicable to our climatic conditions; it may be possible to alter the time of year of greatest productivity by providing shelter and other conditions which would modify the natural tendency of the White Leghorn to attain its maximum production later in the spring than the "sitting" breeds.

The Copenhagen trials⁽¹⁴⁾ showed that Plymouth Rocks laid more eggs than Leghorns during the winter months. At first sight this might seem to contradict the statement made above, that high-producing hens lay more eggs in the winter months, but it possibly may be due to the fact that Plymouth Rocks go broody and so reduce the summer yield (see "Broodiness" above, p. 1026).

Effect of Egg Production on Body Weight of Hen.—The effect of high egg production on the body weight of the hen was studied at the Copenhagen trials, and it was found that, although the weight of the birds increased with age up to the end of the second year, yet within each year the weight of the hen's body undergoes certain variations. Increase in weight takes place from the autumn to the spring, and then during the spring and summer the weight decreases. This seasonal change in weight was especially noticeable in good layers.

Kirkpatrick and Card⁽¹⁷⁾ also found that hens were heaviest on 1st March, before the period of maximum egg production, and lightest on 1st May, after the period of maximum production. In this connection the observations of Wieninger⁽²⁶⁾ are interesting; he found that within any one breed the best layers had the lowest body weight. Thus, in a flock of Golden Wyandottes he noticed that the best layers averaged 2.4 kilos in weight, whereas the worst layers averaged 2.6 kilos. In the Italian Partridge breed the best averaged 2.1 kilos and the worst 2.4 kilos (a kilogram is 2 1-5th lb.)

Attempts have been made at the Harper Adams College⁽²⁷⁾ to discover some relationship between the shape of the bird

(26) *Wiener Landw. Ztg.*, No. 26, 1912.

(27) *Utility Poultry Journal*. Harper Adams College, No. 12, 1917-18.

and the number of eggs laid. The distance from the hind end of the keel to the pelvic bones was thought to be the best guide to laying capacity.

Effect of Exercise.—In America experiments have been made to compare the egg production of fowls allowed free range with those in confinement. Buss⁽²⁸⁾ found that exercise increased the production of eggs, and similar results were obtained by Kirkpatrick and Warner.⁽²⁹⁾ The latter put up two pens of White Leghorns, each of 40 birds; the first pen was confined and the second had the run of a yard. The following table shows the number of eggs laid by the two pens:—

Weeks of Experiment.	1st—13th.	14th—26th.	27th—39th	40th—52nd.	Total for Year.
Confined	179	1 221	1,589	1,483	4,472
Run in Yard	466	1,285	2,079	1,525	5,355

Size of the Egg.—The size of the egg laid by the hen is undoubtedly a breed characteristic. It was found in the trials at Copenhagen⁽¹⁴⁾ that the average weight of eggs was greater in the Minorcas and Leghorns than in the Wyandottes and Houdans. Kirkpatrick and Card⁽³⁰⁾ found that the average weight of twelve eggs of various breeds was as follows:—Rhode Island Reds 1.60 lb., Plymouth Rocks 1.58 lb., Leghorns 1.50 lb., and Wyandottes 1.48 lb.

Murphy⁽³¹⁾ in Ireland, who investigated the inheritance of the size of eggs, found that, when a hen laying a large sized egg was mated with a cock, the son of a similar hen; the pullet offspring invariably laid eggs of large size. In America, also,⁽³²⁾ it has been shown that ability to lay large, heavy eggs is inherited.

The size of the eggs laid by any hen, however, varies with the time of year. Atwood⁽³³⁾ discovered that the eggs are heaviest from November to April and lightest from May to October; thus a pen of hens in February laid eggs which averaged 12.72 lb. per 100 eggs, whereas the same pen in June was laying eggs which averaged only 11.07 lb. per 100 eggs. A possible explanation of this fact is suggested by Warner

(28) *Ohio Sta. Bul.*, 1916.

(29) *Pennsylvania Sta. Rept.*, 1914.

(30) *Connecticut Sta. Bul.*, 1915.

(31) *Dept. Agr. and Tech. Instr.*, Ireland, *Jour.*, No. 2, 1917.

(32) *Bul. Rhode Island State College*, No. 4, 1918.

(33) *West Virginia Univ. Agri. Exp. Sta. Bul.* No. 145, 1914.

and Kirkpatrick,⁽³⁴⁾ who noticed that small eggs were laid at a time when the hen is laying most heavily. Brown,⁽³⁵⁾ however, found with White Leghorns that there is nothing to indicate that high production is responsible for any diminution in the size of the egg, and Murphy⁽³¹⁾ found that small eggs were not always coupled with heavy production.

In the Copenhagen trials⁽¹⁴⁾ it was observed that the weight of the egg appeared to increase with the age of the hen, and it is a matter of common observation that pullets lay smaller eggs than do mature hens. It has been pointed out above that the first egg laid in the cycle is usually the heaviest.

Colour of the Egg.—Very little is known concerning the causes which influence the colour of the egg shell. Tinted egg shells are supposed to be due to products of hepatic origin (bile pigments) secreted by certain glands of the oviduct.

Laurie⁽³⁶⁾ found in Australia that the tinting was less marked in warm weather. Tinted shells, however, are undoubtedly chiefly a matter of breeding, although Lewis and Thompson⁽³⁷⁾ in America have observed that some hens produce eggs varying widely in colour, while others show a marked uniformity in this respect.

The colour of the yolk is no doubt greatly influenced by the food of the hen; thus Henriques and Hansen⁽³⁸⁾ found that hens fed on grains gave a light yellow yolk while grass and herbs produced a dark yellow yolk, and a diet of worms gave yolks of a reddish hue. Opperman⁽³⁹⁾ in America, who experimented with lots of forty White Leghorns, found that feeding on yellow maize produced a rather deep yellow, while wheat meal gave a very pale yolk. Hink,⁽⁴⁰⁾ who fed acorns to fowls, noticed that they produced yolk of a dirty brown colour.

From these experiments and from those quoted above on the effect of egg production in reducing the yellow colour of the legs and ear-lobes in certain breeds, it would appear that the colouring matter of the yolk of the egg is derived from the colouring matter of the fat of the body. The colouring of the body fat is in turn derived mainly from the green colouring

(34) *Jour. Heredity*, No. 3, 1916.

(35) *Jour. Bd. of Agric. and Fisheries*, No. 3, 1916.

(36) *Jour. Dept. Agric.*, S. Australia, Nos. 9—10, 1915.

(37) *New Jersey Sta. Rept.*, 1915.

(38) *Skandin. Archi. f. Physiol.*, Vol. XIV., 1905.

(39) *Country Gentleman*, No. 9, 1914.

(40) *Deutsche Landwirt. Tierzucht*, No. 29, 1915.

matter of plants, much in the same way that the colour of butter fat is produced.

Fertility of Eggs.—It has been found in pigeons that the presence of the male stimulates egg production in the female, but experiments on a small scale with fowls have shown very little effect. Nelson⁽⁴¹⁾ kept two pens of 10 hens each for a year, one pen with a cock and the other without; the yearly average egg yield per hen in the former was 126, and in the latter 118. There were no differences in the keeping qualities of the eggs from each pen.

Numerous investigators have observed the time that elapses, after the cock has been put with the hens, before the first fertile egg is laid. In the trials at Copenhagen⁽⁴²⁾ it was found that the first fertile eggs were produced three or four days after mating.

Observations have also been made as to the time a hen remains fertile after the cock is removed from the pen. Chappellier⁽⁴³⁾ found it to be 10 to 18 days. Elford⁽⁴³⁾ states that a drop in fertility of the eggs occurs on the sixth day after removal of the cock, while at the tenth day only 50 per cent. of the eggs are fertile, by the nineteenth day only 16 per cent. are fertile, and thereafter all are infertile. Philips⁽⁴⁴⁾ observed that no fertile eggs were laid after the fifteenth day from the last mating. Kaupp⁽⁴⁵⁾ concluded from his experiments that it is not advisable to save for hatching eggs laid five days after the cock has been removed. He also states that if hens have been running with a mongrel cock and are required for pure breeding it would be safe to mate them eighteen days after the mongrel cock has been removed, i.e., fertility is considerably reduced after five days, but a number of eggs remain fertile up to the eighteenth day.

In-breeding.—No extensive investigations on the effect of in-breeding on the fertility of the eggs have been made. Gray and Kaupp⁽⁴⁶⁾ found that when daughters were bred to their sires the fertility of the eggs was only slightly reduced, but the hatchability of the eggs was affected to the extent of 10 to 30 per cent. Indeed, as in-breeding is so often used by poultry keepers to fix characters, and as cross-breeding is so

(41) *New Jersey Sta. Rept.*, 1906.

(42) *Compt. Rend., Ass. Franc. Adv. Sci.*, 1914.

(43) *Canada Exp. Farms Report*, 1916.

(44) *Jour. Amer. Ass. Instr. and Invest. Poultry Husbandry*, No. 4 1918

(45) *North Carolina Exp. Sta. Bul.*, 1915.

(46) *North Carolina Station Report*, 1917.

frequently resorted to by commercial poultrymen in order to increase the vigour of the strain, it is remarkable that practically no experiments have been made to determine the effect of in-breeding and crossing on the fecundity, fertility and size of the bird. Research on these lines might lead to valuable conclusions.

Elimination of Cockerels.—Punnett⁽⁴⁷⁾ has shown that breeders may eliminate at once all cocks from their hatch of chicks and rear only pullets, provided certain colour crosses are made. By mating hens of some breeds with cocks of a different colour the male chicks can be picked out as soon as they are hatched and disposed of, thus ensuring that all accommodation is available for rearing pullets. If a black cock is used with barred Plymouth Rock hens, all the male chicks are barred and all the females are black. The male barred chicks can then easily be identified at hatching by the white patches of down on the head and rump.

A silver coloured hen transmits silver to her sons and gold to her daughters in the same way. Silver and Gold Laced Wyandottes are examples of this, as also are breeds such as Light Dorkings (silver) when crossed with Brown Leghorns (gold).

In conclusion it must be emphasized that many of the observations and experiments quoted above have been made only on a small scale and that many, before they are generally accepted, should be repeated under the conditions existing in this country.

(47) *Journal Bd. of Agric.*, Vol. XXV., Feb., 1919.

A SHELL FACTORY: FOR POULTRY.

THE fame of the English oyster is at least as old as the Roman Empire; it found an honoured place at Imperial banquets. Juvenal, in his Fourth Satire, writes of the Roman glutton who could "discriminate with nicety at the first taste whether the oysters were Circean natives or bred on the Lucrine rocks or from the Richborough (Rutupiae) beds." Through the centuries intervening, the popularity of the oyster has never waned and to this day such entertainments as the Oyster Feast, celebrated annually at Colchester, are attended by some of the most admiring and eloquent lovers of shell-fish. In these circumstances, a threat to the oyster fisheries of Colne and Blackwater and elsewhere is a threat not only to a thriving industry but to the continuity of a great tradition, and it is an unfortunate fact that the oyster has found a deadly enemy, though one that does not seek deliberately to treat the victim either as a foe or as a source of food. The Slipper Limpet (*Crepidula fornicata*) lives side by side with the oyster, sometimes even attaching itself to the oyster shell, and competes with it for the food supply. Unfortunately too, it multiplies more rapidly than the oyster, to which it bears a relation similar to that between weeds and a neglected crop. Where the limpet does attach itself to the oyster shell—this happens only in a minority of cases—the injury is direct. In the presence of such an unwelcome guest the oyster is quite unable to pivot upon its axis and feed in the conventional fashion of its kind, so it has no choice but to die uncomfortably in its bed. A few years ago the mortality from all causes was growing so steadily that (in 1916) a big effort was made to deal with the problem. At West Mersea, in the centre of the Colchester oyster fisheries district, an old barn was set apart as a factory and, under the direction of Dr. H. L. Jameson of the Ministry of Agriculture and Fisheries, a spirited attempt was made to save the threatened industry. A drying machine and a crushing machine were installed, and fishermen who saw their means of livelihood diminishing steadily as the slipper limpet extended its ravages, were invited to enter upon new activities and dredge for their enemy instead of their friend.

To-day they carry the catch to an uninhabited spit between Tollesbury and West Mersea, where it remains for six months, by the end of which time nothing is left but shell. The shells are then brought in wagons to a dump outside the barn whence they are carried to a point where, by means of a series of buckets

on an endless chain, they are passed through a furnace which takes the last particles of moisture away and leaves them in a completely inoffensive condition. From the furnace they are conveyed to a disintegrator which grinds them into three sizes, coarse, medium and fine, each being received into separate sacks. This ground shell may be used for poultry instead of oyster shell, which is so much more difficult to procure and so much more expensive; it has a similar lime content. The demand is considerable and grows steadily, so that an increase of output is indicated. The drying furnace is an emergency machine, obtained in 1916, but it cannot keep pace with the more modern crushing plant, consequently a new drying machine is to be installed. This will be capable of handling about 4 tons of limpet shells per hour, and these in their turn will produce 3 tons of finished product. The present crushing installation is capable of handling 10 tons a day while the furnace cannot yield more than 6.

It is interesting to learn that the whole plant, which can treat the shells collected by 30 or 40 fishermen, and employs about a dozen workers in the handling, is entirely self-supporting, and under the rather restricted conditions that obtain at present, is turning out annually over a thousand tons of crushed shell for poultry. With the increase of plant, the output will be increased very considerably, and there is unfortunately no likelihood of the industry coming to an end because slipper limpets multiply rapidly. Only as the result of years of strenuous dredging is it likely that the oyster grounds will be able to maintain themselves.

There is one other side to the industry at West Mersea which calls for passing comment. Quite apart from the shell for poultry, there is a very important by-product, of which a visitor to the factory can hardly fail to take note. This is a fine powder, from which nobody working in the neighbourhood appears to be quite free. The dust is 66 per cent. pure lime and is of the greatest value on sour ground. At present there is a very high mound of it, a mound that increases day by day, but unfortunately the cost of transport renders marketing impossible.

Perhaps the most interesting aspect of the whole business is that it provides an instance of a pest bringing about the creation of a profitable industry, which enables those who have been hard hit by a trouble to turn that trouble to account.

PROFITABLE EGG PRODUCTION : HIGH PRODUCTIVITY ESSENTIAL.

THAT the most important factor in profitable egg production is high productivity is exemplified by the experience of a member of the Ministry's staff. The original birds of the small flock were Wyandottes, obtained from one of the Incubating Stations which were first established by the Ministry of Agriculture in 1915. One of the objects of these stations is, by distributing stocks of high laying capacity, to encourage poultry keepers to eliminate the unproductive barn door fowl from their flocks.

Of six birds comprising the original pen, three were sold on 15th September last. Five pullets, the sire of which was a Wyandotte cock of the same strain as the earlier birds, were raised during the year. These came into lay at the middle of August. The standard daily ration of each bird during the year was 4 oz. of concentrated food, composed of 2½ oz. mixed grain (wheat, oats and maize) and 1½ oz. meal (bran, middlings and fish meal) in varying proportions. The meal was used for drying off a warm mash of household scraps. In addition, a small supply of green food was provided.

The following Profit and Loss Account covers the period of the year ended 15th November last; it includes the cost of rearing the five pullets mentioned above:—

DR.	PROFIT AND LOSS ACCOUNT			CR		
	£	s.	d.	£	s.	d.
1,556 eggs, valued at wholesale prices ...	30	8	5	Cost of Live Stock and Equipment (cash) ...	18	4 3
Stock sold (cash) ...	2	5	0	Cost of Food (cash) ...	11	5 0
Equipment in hand at end of year, valued at cost, less 20 per cent. depreciation...	7	0	0	PROFIT ...	17	19 2
Live stock in hand at end of year, valued at market prices (3 hens, 5 pullets, 1 cock) ...	7	15	0			
	<hr/>				<hr/>	
TOTAL	£47	8	5	TOTAL	£47	8 5

An analysis of the accounts yields some interesting information. For instance, the average daily cost of food of each bird was 1d., while the average value of one egg (at wholesale prices) credited was 4.7d. Each egg cost 1.7 in food to produce, and each hen of the original stock laid an average of 232 eggs during the year. Two hens were off laying for a period of six weeks

while rearing chicks, but no deduction has been made on this account. The aggregate number of hen-days (including pullets in lay) was 2,470. Including the pullets, therefore, the average number of eggs laid per bird per day was 0.6, equivalent to 18 per month. Again, the cost of food for each laying hen for the year was £1 10s. 6d. By writing off at the end of the year the sum of 5s. for depreciation in the value of the bird, 5s. for depreciation in the value of the equipment, and 8s. for part cost of the cock, the total cost of keeping each laying hen was £2 8s. 6d. As each hen of the original stock laid 232 eggs during the year, realising the sum of £4 10s. 10d., the net profit per laying hen may be estimated as £2 7s. 4d.

A profit could not be shown, however, unless the hens were of high laying capacity. For instance, if, instead of each hen laying 232 eggs during the year, it had laid only 110 eggs the profit of £2 7s. 4d. per hen would have disappeared.

This enforces the point that it is the object of this note to bring out, namely, that high productivity is essential to profitable egg production, and high productivity can only be obtained by keeping stock of high laying capacity.

SYNTHETIC NITROGENOUS FERTILISERS.

E. J. RUSSELL, D.Sc., F.R.S.,

Director of the Rothamsted Experimental Station.

A SYNTHETIC substance is one that is prepared from its elements; synthetic nitrogenous fertilisers, therefore, are those produced in the factory from their elementary constituents instead of being obtained as by-products of some manufacturing process, as is the case with sulphate of ammonia.

So far as the farmer is concerned it is quite immaterial how the fertiliser is made so long as it contains no harmful ingredients, and his chief interest is to obtain adequate supplies at as low a cost as possible. The name "synthetic" is therefore of manufacturing interest but of no agricultural consequence.

It so happens that the fertilisers which the manufacturers find it easiest to make are rather different from those now obtainable. It would be quite easy to manufacture nitrate of soda in the factory, and the product would have the same fertiliser value as the natural nitrate imported from Chili, but it is rather easier for the manufacturer to prepare nitrate of lime; hence this course is adopted. Similarly, sulphate of ammonia could be prepared synthetically without much difficulty; it is, however, easier to make chloride of ammonia, and it is likely, therefore, that this fertiliser will be produced. Each of these fertilisers, in addition to giving increases in crops, has some special property which may be of value to the farmer, while the widening of the sources of supply is of course of considerable importance at the present time.

The question of making synthetic fertilisers was first opened by the late Sir William Crookes in 1898 in an address to the British Association, which at once caused a great deal of discussion. Sir William pointed out that the population was increasing more rapidly than the area under wheat, and consequently a time must come when wheat supplies would be insufficient unless the production per acre could be raised.

In order to meet this contingency he proposed that the supply of nitrogenous fertilisers should be increased so as to ensure progressive increases in crop yields. He further pointed out methods by which nitrates could be made artificially. This principle was carried into practice at Notodden in Norway and subsequently at Niagara, where factories were erected and considerable amounts of nitrates produced. For purposes of convenience nitrate of lime was made, although, as already stated, nitrate of soda could equally well have been produced, but at greater expense.

The process requires considerable power, and the great advantage possessed by Norway and Niagara, where cheap water power is obtainable, is therefore evident.

The second process, requiring somewhat less power, gives rise to calcium cyanamide or nitrolim. This was first made at Piano d'Orte in Italy, and is now produced at Odda in Norway, Alby in Sweden, at Niagara and elsewhere.

Had the fertiliser problem alone been involved nitrate of lime and nitrolim would probably have been the only fertilisers produced synthetically, and their manufacture would have been confined to places where cheap water power was available. Just before the War, however, it was found that ammonium nitrate could be used as a high explosive of very great power, and the German chemists proceeded to devise methods whereby it could be easily obtained in quantity from the air. A satisfactory method was developed by Haber for producing ammonia from the air, and a second process was worked out by Ostwald for converting this into nitrate. The necessary factory developments were made, and by the middle of 1914 the process was working on a large scale at the Badische Anilin Fabrik, Ludwigshafen. The War naturally caused remarkable developments in all the belligerent countries, and in consequence the technical difficulties have been very largely overcome. As a result the manufacturer is now able to prepare the following substances, the nitrogen in each case being derived from the air:—

Nitrate of Lime,	Chloride of Ammonia,
Nitrate of Ammonia,	Calcium Cyanamide, or Nitrolim,
	Urea.

Nitrate of Lime.—This substance has been manufactured in Norway since 1907, and has formed the subject of many fertiliser trials in this country and abroad. An idea of the rapidity with which its use was spreading before the War is

obtained from the following figures showing the quantities exported from Norway:—

*Exports of Nitrate of Lime from Norway :
Metric Tons per Annum.*

1907	...	...	1,344
1908	...	...	7,053
1909	...	...	9,422
1910	...	...	13,531
1911	...	...	9,805
1912	...	...	51,701
1913	...	...	70,927
1914	...	...	75,176

During the War great modifications took place, and the exports fell to nearly one half of the 1914 figure:—

1915	...	...	38,609
1916	...	...	46,001
1917	...	...	35,921

This was partly due to the diversion of acid to the manufacture of ammonium nitrate, and partly to a rise in the home consumption; before the War Norwegian farmers used only 6,000 or 7,000 tons of nitrogenous fertilisers per annum, whereas in 1917 they used 20,000 tons, and the estimated quantity for 1918 was 55,000 to 60,000 tons. The Norwegian Company, the "Norskhydro," has, however, allowed for expansion, and there is no reason to fear any failure of supplies.

Experiments show that nitrate of lime comes nearer to nitrate of soda than any other fertiliser. Like nitrate of soda it is rapid in action, easily soluble, improves the colour and appearance of crops, and induces quick growth. It differs from nitrate of soda in four respects:—

1. It contains no soda, which on some soils is a useful fertiliser for grass and mangolds.
2. It contains calcium, which is often of value in improving the vigour of plants.
3. It is very soluble in water, and in some cases may prove too soluble, so that there may be difficulty in handling; this problem, however, was being studied before the War, and the difficulty is now probably overcome.
4. It does not "poach" heavy soil, and can therefore be used without damage to the texture.

On balance there is probably not much to be said for the differences, although in individual cases some of them may assume importance. On the whole, nitrate of lime has usually proved as effective a fertiliser as nitrate of soda, sometimes the

one and sometimes the other giving the better results. The following are the results of some experiments:—

Mangolds.										
Midland Agric. Coll., 1915. (1)					Gloucester. (2) (3)					Reading, 1909. (4)
					1909.		1910.		Chalk soil.	Strong loam.

1.—Harper Adams Agric. Coll. Repts. 1909 and 1910, p. 33.

2.—Glos. Repts. 1909 and 1910, p. 74. Table I.

3.—Royal Agric. Coll. Repts. Cirencester 1910, p. 31.

4.—Reading Univ. Coll. Dept. Agric. 1909. Bull. vii. p. 11.

Potatoes.					Barley.		Wheat.	
	Woburn, 1909. Sandy loam. (1)	Devon. Light soil. (2)	Jersey. (5 centres) (3)	Aberdeen various centres, 1907-9. (4)	Rothamsted, 1909. Grain. Straw.		Rothamsted, 1910. Grain Straw	
	<i>l. cwt.</i>	<i>l. cwt.</i>	<i>lb per perch</i>	<i>l. cwt.</i>	<i>bush.</i>	<i>lb.</i>	<i>bush.</i>	<i>lb.</i>
Nitrate of soda..	15 9	10 15	221	9 5	48.1	28.2	27.0	2760
Nitrate of lime.	15 6	10 7	228	9 6	46.2	44.9	26.7	2618
No nitrogenous top dressing }	14 12	9 18	195	8 6	28.7	26.9	15.4	1528

1.—J. Roy. Agric. Soc. 1909, p. 38.

2.—Devon C. C. Rept. 1907-9, p. 6

3.—State of Jersey Field Expts 1911, p. 2.

4.—Aberdeen and N. Scotland Coll. Leaflet 9, p. 2.

It is interesting to note that these results agree substantially with those obtained in Germany and Austria. In order to avoid the use of foreign measures the results are calculated to an average value of 100 for nitrate of soda:—

	Rye.	Wheat.	Barley.	Oats.	Potatoes	Sugar beet.	Mangolds	Average of all.
Nitrate of soda ..	100	—	100	100	100	100	100	100
Nitrate of lime ..	97	105	110	109	102	97	73	99

These results show that a farmer will be fairly safe in regarding nitrate of soda and nitrate of lime as equally effective per unit of nitrogen, but he must be prepared to find differences which are smoothed out in the above average results, but which may operate on his farm.

Unfortunately for buyers, nitrate of soda and nitrate of lime do not contain equal amounts of nitrogen, so that a direct comparison of price is misleading; comparison can be made only by calculating the price of 1 per cent. of nitrogen in each case. As a rule nitrate of soda contains 15½ per cent. of nitrogen and nitrate of lime 13 per cent.

Nitrate of Ammonia.—Nitrate of ammonia is essentially a wartime product. The Norwegian exports were, in metric tons, per annum:—

1910	...	..	...	—
1911	..	...	...	3,024
1912	...	...	...	4,270
1913	...	...	...	9,107
1914	...	...	...	11,959
1915	...	...	...	26,459
1916	...	...	.	59,639
1917	...	...	...	63,578

The German production is estimated as follows, in metric tons:—

1912	...	...	...	—
1913	...	...	..	20,000
1914	...	...	...	40,000
1915	...	...	...	100,000
1916	...	...	...	200,000
1917	...	...	...	333,000

The figures for 1916 and 1917 lack confirmation, but they were undoubtedly high.

There was also a considerable production in this country, but it was from pre-existing nitrogen compounds, so that the material could not be described as synthetic. The Nitrogen Products Committee of the Munitions Inventions Department* carried out experiments during the War, as the result of which a factory was started at Bellingham: since the War this factory has been taken over by a private company. Large quantities of ammonia will be produced and then converted into a suitable salt. Ammonium nitrate presents no technical difficulties, and could easily be prepared in sufficient quantity to satisfy any agricultural demand. In peace time it can be used as fertiliser; should, unhappily, another war break out it can be used as explosive.

Numerous experiments have been made with ammonium nitrate as a fertiliser. It has proved to be very quick in action, and well suited to horticulturists, market gardeners and others using large amounts of nitrogenous manure and desiring speedy effects. It is also effective on the farm. Comparison has not always been made with the same substance; sometimes nitrate of soda has been used as the standard, and sometimes—as at

* A note on the Report of this Committee was published in this *Journal*, February, 1920, p. 1112.

Rothamsted during the War—sulphate of ammonia. Some of the results are:—

	Aberdeen.					Newton Rigg.	
	Hay, cwt. per acre.			Oats, lb. of grain per acre.		Mangolds, tons per acre.	
	1911-14 General Average.	1913. 8 centres	1914. 3 centres.	1911.	1914.	1913.	1914.
Nitrate of Soda	57.8	69.2	57.8	9644	2280	20½	23½
Nitrate of ammonia	56.2	69.7	59.9	2787	2427	14½	21½
No nitrogenous top dressing	50.2	65.7	58.4	2477	1853	—	—

		Rothamsted, 1918.				
	Mangolds.	Wheat				
		Potatoes.	Expt 1		Expt. 2	
			t. per ac	cut per ac	Grain bush	Straw. lb.
Sulphate of ammonia	18.6	175.4	41.3	5250	40.1	4830
Nitrate of ammonia ..	23.3	174.5	44.7	5070	37.7	5050
No nitrogenous top dressing	17.3	160.9	38.6	4684	31.6	4520

In the Aberdeen experiments the ammonium nitrate was somewhat better than nitrate of soda, while at Newton Rigg it was inferior in action; in the latter case the soda may have had some specific effect. At Rothamsted the ammonium nitrate was better than the sulphate for mangolds, although judging by the character of the haulm it was less suitable for potatoes and might have given less crop had there been disease. It is much more concentrated than sulphate of ammonia or nitrate of soda, containing as a rule about 34.8 per cent. of nitrogen, of which one half is in the form of ammonia and one half nitrate. It must therefore be used sparingly—only $\frac{1}{2}$ cwt., or even less, should be applied—and there may be difficulty in ensuring that these quantities are not exceeded. This matter, however, is within the farmers' control.

Another and more serious difficulty is that ammonium nitrate tends to become wet and form a hard cake, which, however, is readily broken with a wooden mallet. Some kinds used to become very damp, but technical chemists learnt a good deal during the War and found ways of mitigating this disadvantage. The factor that will finally determine whether ammonium nitrate remains on the market as a fertiliser is the cost. If nitrate of soda is obtainable at £20 per ton, nitrate of ammonia is worth

about £87 5s.; and unless it can be produced at this figure it is not likely to command an extensive sale.

Ammonium Carbonate.—It would not be a difficult matter to prepare ammonium carbonate synthetically, and as a fertiliser it would have the advantage that it could not cause soil acidity, while it would be at least as effective as sulphate of ammonia. Samples have already been prepared: one sent to the Rothamsted laboratories contained 25.5 per cent. of nitrogen and another contained 18.4 per cent. Ordinary sulphate of ammonia contains about 20 per cent. Unfortunately, however, the material is very volatile and rapidly loses ammonia, and until this difficulty can be overcome it offers little prospect to the farmer.

Ammonium Chloride.—From the financial point of view the most promising synthetic ammonium salt is the chloride, which is likely to be turned out in great quantity in this country in the near future. In the past it has been practically untested by British investigators; the large production of sulphate of ammonia appeared to rule out any possibility of the manufacture of the chloride. For many years it was used at Rothamsted in conjunction with sulphate of ammonia, but no careful comparison between the two salts was made.

On general grounds it might be supposed that the chloride and sulphate of ammonia must be of equal fertiliser value. There is, however, much physiological evidence to the effect that chloride under certain conditions may be harmful to plant growth. It by no means follows that this would happen in practice; whether it would or not can only be ascertained by trial. In view of the technical importance of the salt, an extended investigation is to be made.

Urea.—During the War several patents were taken out in Germany for the manufacture of urea as a fertiliser. Urea has the advantage of being highly concentrated, containing no less than 47 per cent. of nitrogen, an enormous advantage for the export trade. Whether it would have equal advantages for the home trade is not so clear. A field experiment is being carried out this year at Rothamsted.

Cyanamide or Nitrolim.—This substance is already well known as a fertiliser, although during the War it was not readily obtainable by farmers. The growth of its manufacture

was very rapid before the War, the number of metric tons produced in the different countries being, in total:—

1906	...	...	...	500
1907				1,700
1908				2,510
1909				11,550
1910				20,495
1911				54,506
1912				104,938
1913				156,944

During the War the expansion in producing capacity of the various works was astonishing:—

1914	...	...	...	194,726
1915	...	...	...	771,155
1916	...	...	...	981,500

Most of the expansion took place in Germany. Arrangements are now being made for the establishment of works in this country.

It is usual to compare nitrolim with sulphate of ammonia. The broad result of all the trials is that nitrolim is somewhat slower in action than the sulphate, and is better drilled with the seed than used as a top dressing. Taking successes and failures together, the value of the nitrogen in nitrolim can be expressed as 90 if that in nitrate of soda is expressed as 100: sulphate of ammonia comes in between at 96.6. Some of the failures, however, doubtless arose from improper use, and it is quite probable that a better average will be made in the post-war period. Experimental results obtained at Rothamsted and elsewhere show how some of the failures arose. A certain poisonous impurity may be present, which, however, the technical chemists can no doubt avoid, and a certain preliminary decomposition has to take place in the soil, the effective agent for which may not always be present. The fault lies not so much in the material as in our defective knowledge of the proper conditions for using it; fortunately, this is a matter that can be put right. Those concerned in this country fully realise these difficulties and will no doubt find a way out.

Among many experimental results, the following may be quoted:—

	Potatoes					
	Woburn, 1908. Sandy Loam.		Devon. Light Soil.		Jersey. (Five Centres).	Aberdeen. (Various Centres) 1907-8.
	t.	cwt.	t.	cwt.	lb. per perch.	t. cwt.
Sulphate of ammonia ..	13	13	12	6	222	9 13
Nitrolim ..	15	7	12	0	222	8 17
No nitrogenous fertiliser ..	12	12	9	18	186	8 6

	Mangolds.		Barley		Wheat.	
	Reading.		Rothamsted, 1909		Rothamsted, 1910.	
	Strong Loam.		Grain.	Straw.	Grain	Straw.
	<i>tons</i>	<i>cwt.</i>	<i>bush.</i>	<i>lb.</i>	<i>bush.</i>	<i>lb.</i>
Sulphate of ammonia	28	1	49.1	2517	24.6	2964
Nitrolim	28	3	45.2	2076	22.4	2843
No nitrogenous fertiliser	28	3	28.7	2619	15.4	1926

The results are better than those reported from Germany and Austria; putting the nitrogen in nitrate of soda at 100 the values for sulphate of ammonia and nitrolim are:—

	Rye.	Wheat.	Barley	Oats.	Potatoes.	Sugar beet.	Mangolds.	Average of all.
Sulphate of ammonia	98	54	89	97	94	95	68	84
Nitrolim	74	87	75	79	78	66	72	76

There are, however, some abnormal results here; allowing for these the German authorities, in framing their "monopoly law" of 1915, fixed the following value:—

Nitrogen in nitrate	...	...	100
" ammonia	...	...	91
" nitrolim	...	...	83

In this country we should give higher values to ammonia and nitrolim, setting them at 96 and 90 respectively.

The composition of nitrolim has varied slightly since it was first introduced. In the raw state it contains 19.5 per cent. to 20.5 per cent. of nitrogen, which makes it suitable for chemical works, but not for farmers. It contains carbide that needs to be decomposed by water, and dust that has to be fixed by oil. These processes bring down the nitrogen first to 18.5 per cent. and then to 15 or 16 per cent.; just before the War a modification in the granulating process brought it down to 14.5 or 15 per cent.

PIT, TRENCH, AND OTHER IMPROVISED SILOS*

A. W. OLDERSHAW, M.B.E., B.Sc.,

Agricultural Organiser for East Suffolk.

THE ensilage system in farming seems to be rapidly increasing in popularity in this country. The chief obstacle to its further extension appears to be the very high cost of concrete or wooden silos, and it is desirable, therefore, that all other methods should be considered which would involve a smaller outlay of capital and would give satisfactory results.

Pit Silos.—In previous issues of this *Journal*† attention has been drawn to the making of silage in “trenches.” The term “trenches” has been used to describe rectangular holes, 3 or 4 ft. deep, as distinguished from the cylindrical “pits” of about 20 ft. or so in depth and 12 to 16 ft. in diameter, used in America. Deep pit silos can only be used where both soil and sub-soil are very dry, so that there is no fear that water may have access. Silos of this nature were excavated some years ago by Mr. H. C. Boggis, of Wrentham, Suffolk, on his farms at Easton Bavents, near Southwold. There is not always sufficient green material available to fill the silo, however, since the land at Easton is very light and subject to drought, and Mr. Boggis keeps on his arable land a flock of sheep, which in a dry May and June require all the green food he can grow. When filling this pit silo the green material is simply chaffed and allowed to fall into the pit, until the latter is full. Galvanised iron is arranged round the pit to a height of 6 ft. to enable the green stuff to be heaped above the ground, since the material sinks when allowed to settle. The silage is removed from the pit by means of a hoist.

In America, where this type of silo is quite common, the inside of the pit is often lined with cement. The best way to construct such a silo is to excavate a circular hole of the required diameter a few feet deep, line the side with cement, and then continue excavating and cementing until the required depth is reached. The bottom of the pit may also be lined

* A paper read at the Agricultural Organisers Committee of the Agriculture Education Association held at Cambridge, July 1920.

† “A Simple Method of Making Silage,” July, 1919, p. 450; and “Preserving Green Fodder—An Inexpensive Trench Silo,” April, 1920, p. 65.

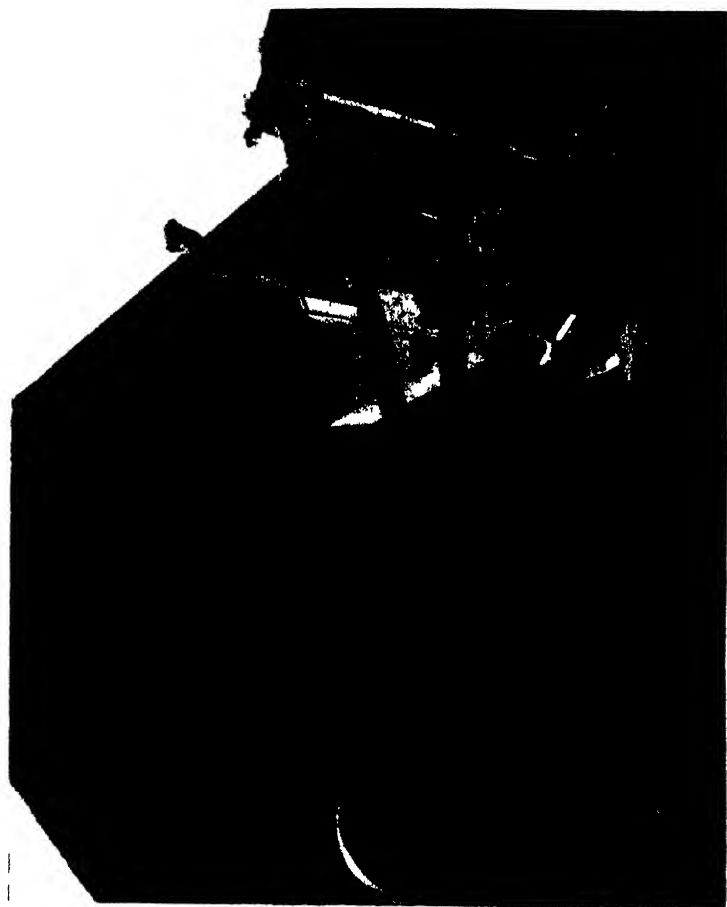


FIG. 1 —Showing home-made Elevator with endless chain and slats

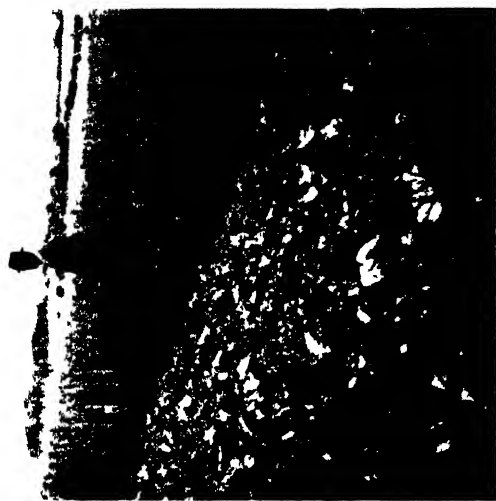


FIG 2 Fodder for Enslage in growing stage.

with cement, but this is not necessary if the soil is very dry. A layer of cement one inch thick on the inside is found to be sufficient; it is not even essential to line the sides at all. In order to lift the soil from the pit, and later, when the silo has been filled, to remove the silage, a hoist or rough wooden crate, with pulley attached, is erected near the mouth of the pit.

The advantage of this type of silo is that it is inexpensive. There is, however, some danger that human beings or animals may fall into the pit unless a curb of concrete is made 3 ft. or so high around the margin. Where the pit is deep there is also danger of poisonous gases accumulating at the bottom, with the risk of suffocation to the men who descend to remove the silage. A lighted lantern lowered into the pit, however, will serve to indicate whether any poisonous gases are present. If the light goes out it is dangerous to descend, and the air should be agitated to allow a current of pure air to pass to the bottom of the pit. The labour of removing the silage from the pit is not considered to be greater than that involved in elevating the raw material in the case of cylindrical tower silos. The pit silo on Mr. Boggis' farm at Easton is not lined with cement, but is merely a cylindrical excavation of a diameter of about 18 ft. and a depth of 12 ft. Such a pit would obviously fill with water if dug in any but dry soil. There are, however, in this country many sites where soil and sub-soil are very dry, or which are situated near slopes where there is no possibility of water accumulating and where this type of silo might be used. The green material used should be chaffed, and where this is done the silage made in the pit is quite good. Mr. Boggis fed the silage made in his silo to sheep and cattle quite successfully.

Unused Silos.—There are a number of silos in various parts of the country which were erected 30 or 40 years ago and have fallen into disuse. A farmer who may be fortunate enough to have such a silo on his farm may easily use it to make silage according to modern methods. These old silos are usually rectangular in shape, and not very deep. If, however, they are filled with chaffed green material and the contents are subsequently weighted, excellent silage may be made in them. Such a silo existing on the farm of Mr. Kindred, Pound Farm, Gt. Glemham, was recently filled with a mixture of second crop meadow grass and maize—material which would otherwise have been wasted. This mixture made excellent silage.

Silos made from Old Barns and other disused Farm Buildings.—Quite a number of silos of this type exist, and any farmer having a disused barn or similar building can usually adapt it for use as a silo by the exercise of a little ingenuity.

Figure 1 shows such a barn in use on Mr. Boggis' farm at Wrentham. In this case the walls of the barn were lined with cement, the corners rounded off internally, and one portion partitioned off from the rest of the barn. Short wooden planks fitted in the partition serve to close up the doorway. These wooden planks are removed one by one as the silage level is lowered during the winter. The portion of the barn separated off in this way is 18 ft. high, and the internal dimensions of the floor are 18 ft. by 16 ft. The silage is elevated into the barn through the opening shown in the illustration.

An ordinary chaff cutter, placed on a platform and driven by a tractor, is used. The material is lifted to the barn by means of an elevator of a slanting length of 20 ft., constructed according to Mr. Boggis' suggestions by a local firm. Fixed to the elevator is an endless chain of the type used on binders, with slats fixed at intervals of 2 ft., to carry up the chaffed green material. This elevator cost £16 at pre-war prices, but as it was a new design a second one could probably have been made for a smaller sum. It was found necessary to affix a special bonnet to the chaff cutter, as the ordinary bonnet did not clear the green stuff satisfactorily.

Trench Silos.—In view of the very high price of cylindrical tower silos, whether of the wooden stave or concrete type, it has been thought desirable to investigate further the system of making silage in trenches, so successfully practised by Mr. Wm. Makens, of Colney, Norwich. As previously mentioned in this *Journal** the three trenches used by Mr. Makens vary in size, the largest being 25 yd. long, 4 ft. deep and 5 yd. wide. By the courtesy of Mr. Makens the writer was able to visit Colney when this trench was being filled in June, 1920. It is estimated that the trench will hold about 400 loads of green stuff.

After the heap of green stuff in the trench is well topped up, Mr. Makens covers it up with earth. In winter, when the silage is needed, the earth is removed, and the material is cut out in sections as is done with hay, and is loaded into a cart for conveyance to the stock. The silage is fed in its long state.

* July, 1919, p. 450.

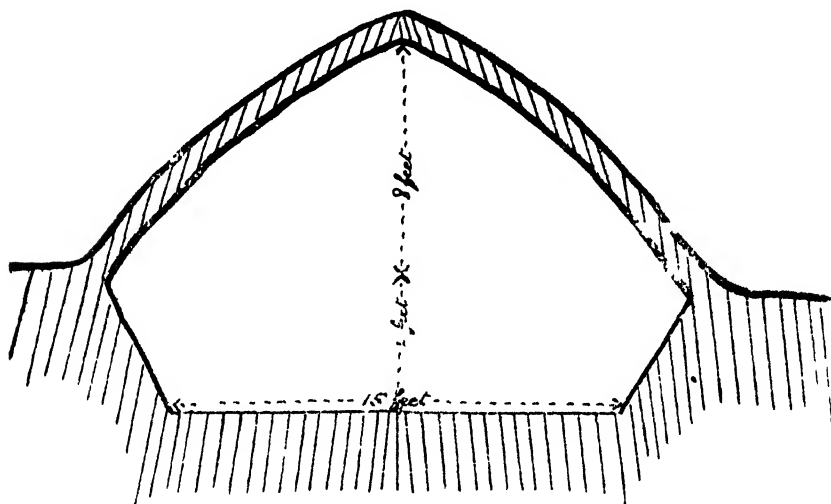
In 1920, Mr. Makens filled the trenches with a mixture of oats and tares and rye and tares. When these crops were examined it was found that the tares had almost smothered out the oats, and that the whole crop was lying flat on the ground, causing some trouble in cutting it. On the other hand the rye and tares mixture stood up fairly well, the whole crop being about 3 ft. 6 in. high. The mixture which proved the more successful was half a bushel of rye and two bushels of winter tares per acre.

There can be no doubt that rye sometimes gets old and woody when sown mixed with tares, but this difficulty can be obviated by cutting the crop in good time—say the third week in June. Early cutting has also the advantage that the land is cleared earlier, and more time is allowed for a bastard fallow, or for ploughing for turnips. There appears every reason to suppose also that as tares become more mature, the proportion of indigestible fibre present in them increases. This is a point, however, which requires investigation. Captain W. A. Doran, formerly of Harristown House, Ardee, states that he made silage of a crop of beans during the summer of 1919, and fed it to the stock in winter with excellent results. This silage was made in a trench, according to Mr. Makens' method and proved most palatable to the cows. There was, however, a certain amount of waste on the sides and top. Inquiry from another farmer who made silage in this way confirms the writer's opinion that the amount of waste depends to a considerable extent on the care with which the heap is roofed up. Unless a good steep roof is made, rain gains access at the top, and rotting ensues. Everyone with a knowledge of farming knows the way in which a hay stack roof will sink, and the roof of a heap of silage sinks much more. It also seems likely that a rough thatch arranged outside the earth roof to keep out some of the winter's rain would be an advantage and would result in less rotting on the top.

The writer is indebted to the Ministry of Agriculture for calling his attention to a letter from Mr. N. A. Gatenby, of Jemolong, Blackheath, New South Wales, in the issue of the *Pastoral Review* for April last. Mr. Gatenby writes:—

“When I first made silage in 1890, I knew only of stacks, and made one with great care—it turned out a hopeless failure The next year I made another, with much the same result. . . . The making in pits is simplicity itself; nothing can be simpler or easier. It is almost impossible

to avoid making good silage. . . . The sides of the pit were almost perpendicular; the slopes at each end about 1 in 6. This allowed the green stuff to be carted in at one end, and the teams to go out at the other. The long roadway slopes also allow the ensilage to be conveniently carted out. Each succeeding load is carted in and thrown off, the carts passing over the previous loads, and giving the necessary pressure required to exclude air. When the pit is full the stuff can be arched up 6 or 8 ft., the carts going over in the same way.



Cross section of French Silo.

Then leave a few days, when it will be found the height will be perhaps 3 or 4 ft. less, through settling down; then build up again, and scoop earth on top, say 2 ft. deep; plough a furrow round to carry off influx of water, and you have first-class ensilage, good for 20 years to come. If the pit bottom is clay, I should advise a shaft a few feet deep, to carry off any extra soakage. I used one layer of saplings along the flat bottom, but as the soil was loamy right through, I doubt if even this was necessary.

"The above seems simple enough, and I never used a thermometer, and have only a hazy idea as to sweet, sour, acid, sub-acid ensilage; what I do know is that, wherever exhibited—Royal Show, or elsewhere—the silage so made has nearly always taken first prize.

"I have often been asked if heavy rain falling as a pit is being filled is harmful, and I have never found it so. I know.

of 3 in. causing no appreciable difference in the subsequent silage; moreover, the greenstuff can always be thrown in wet with dew or rain."

Mr. Gatenby's experience appears to be identical in most respects with that of a number of farmers in this country. It is not suggested that the method of making silage in pits or trenches results in material of the same high quality as that made in cylindrical tower silos, but there is no doubt that thoroughly good silage can easily be made in this way. There is much in this method which should commend itself to the very large class of farmers in this country whose capital is limited and who do not care to invest £400 in a tower silo.

RAT DESTRUCTION BY GOVERNMENT AID.

E. C. READ,

*Technical Adviser to the Rats' Branch of the Ministry of
Agriculture and Fisheries.*

THE damage done by rats to the national food supply, to property and to Public health is a matter of the first importance to the community, and within the last two years the question of repressive measures has been brought home to the country by the Ministry's active propaganda. Much has been done to educate the Public conscience. Instruction has gone hand-in-hand with practical methods of extermination conducted on scientific lines. National Rat Weeks, periods of special effort, have had the most encouraging results, both in regard to the number of rats killed, and in the stimulation of Public interest. It may be claimed that the general Public is at last realising the urgency of dealing with the rat problem, and although much still remains to be done.

Statutory repression of vermin did not originate in 20th Century progressive legislation. In the reigns of Henry VIII and Elizabeth. Statutes enjoining the destruction of rats, mice and even insects were in force. The Account Books of Wardens and Overseers bear witness to payments made out of local funds, primarily ecclesiastical, for such destruction, and these entries continued down to the middle of the 19th Century. As recently as twenty years ago the Local Government Board authorised the payment of rewards for the destruction of rats during an outbreak of *plague* in East Suffolk, and in 1909 a Rats Destruction Bill was presented to Parliament by Sir Charles Maclaren. The Bill was dropped before the second reading, but a few years later the course of events brought the question before the nation in so urgent a form that legislation could be postponed no longer. In 1918, when the German submarine menace had forced this country to augment its supplies of home-grown food, it was realised that the storage of foodstuffs brought about an alarming development in the rat population. This increase in rats meant an enormous increase in the damage done to stores—a fact that no national economist could afford to neglect. Consequently, the Ministry of Food issued the Rats Order, 1918, and the Ministry of Agriculture undertook the administration of that measure with the co-operation of Local Authorities. The next step was the formation of the Rats' Branch of the Ministry on 15th January, 1919.

Two months later an Order amending the Rats Order, 1918, was issued permitting Local Authorities to delegate powers to various minor bodies.

It was found that the permissive powers given to Local Authorities under the Rats Orders did not make for any very general or energetic grappling with the problem, and it became manifest that some wider measure would be necessary.

A noteworthy proof of the growing interest in rat destruction was given by the Royal Sanitary Institute at its Congress held in July, 1919, at Newcastle. The Congress passed the following resolution :—

“ That the Council of the Royal Sanitary Institute be recommended to urge upon the Ministry of Health the necessity of continuing as a health measure the powers conferred under the Rats Order, and that support be given to the Bill dealing with rat destruction now before Parliament.”

Before the end of the year, public feeling had become so much alive to the importance of rat destruction that in December, 1919, the Rats and Mice (Destruction) Act was passed almost without opposition. Strengthened by legal sanction, the Ministry embarked on a policy of combined action on organised lines.

In order to stimulate public action, a pamphlet (D.R.2.) was issued, urging the institution of Rat Weeks. Between October, 1919, and March, 1920, three such periods of special effort were held. The Army Authorities co-operated, the Press gave most friendly assistance, cinematograph managers helped to advertise the scheme, and Rat Clubs and Boy Scouts lent a hand. The value of concerted action within a given area was shown by the estimated returns of rats killed. In many districts the number exceeded 100,000. The following are some results from districts where help was given by the Ministry during 1919. In the county of Southampton 121,500 rats were destroyed between 24th March and 18th June. Throughout the year the county of Hertfordshire showed a record of 285,739 rats destroyed, and in five months Leicester reported a “ kill ” of 125,223. During six months’ operations in Buckinghamshire 22,341 rats were killed; during seven months in Oxfordshire 52,000; during six months in Shropshire, 64,485; and during two months in Staffordshire 62,074. On suggestions made by the Ministry a systematic campaign was organised throughout the country by the Military Authorities. The Military Supply Reserve Depot at Deptford—an area 40 acres in extent—was treated successfully

on lines suggested by the Ministry's Technical Adviser. Further, 7,500 copies of the pamphlet for the guidance of Rat Officers were distributed by the Army Medical Department to all Medical Officers.

During the first National Rat Week 60,000 sets of premises were treated at Bristol, and it is estimated that 200,000 rats were killed. The year 1919 saw excellent progress in acquiring knowledge of devices for rat destruction. The Ministry and the Local Government Board co-operated in an exhibition held at the Royal Zoological Society's Gardens; 300 tests were made to determine the best and safest raticides and it was found that the media suggested by the Ministry, namely, Carbonate of Barium and Red Squill, were not only the cheapest but the most effective. At the instigation of the Ministry almost all makers of proprietary poisons agreed to supply Local Authorities at prices much below their usual rates. The Rats' Branch encouraged the importation of the necessary raw materials, and gave recipes to manufacturers and the public generally, thus enabling them to prepare baits at very low prices. The Rats' Branch was further able to show that the employment of sugar as a means of attracting rats is not essential.

With the additional powers obtained under the Rats and Mice (Destruction) Act, 1919, great progress has been made during 1920 in organising the carrying out of systematic methods of destruction throughout the country.

Not only Government Departments but public bodies—scientific, social, industrial and commercial—are showing an increasing interest in the question of rat destruction. Very clear evidence of this interest was given at the Royal Sanitary Institute's Congress at Birmingham, where the announcement of a special conference on rat destruction drew an audience too large to be accommodated in the hall set apart for the meeting. Papers were read by several experts, including Dr. W. M. Willoughby, Medical Officer to the Port of London, Surgeon-Commander McKeown, and on behalf of Professor Zuschlag. The ensuing discussion brought out many valuable points of interest and information. At the Sanitary Inspectors' Association Conference at Margate the question was earnestly discussed at a special meeting, and at the Conference of Port Sanitary Authorities steps were taken to ensure a properly co-ordinated inspection and fumigation of vessels in port.

At Kew Gardens, which are under the Ministry's supervision, rats had done great damage to valuable wild fowl and had eaten their eggs. In July the Ministry's officials visited the Gardens,

ascertained the extent of the depredations, traced the principal rat runs and laid baits. These precautions have proved most beneficial.

The results of the National Rat Week held on the first six days of November, 1920, were altogether encouraging. The experience of former Rat Weeks had indicated the most suitable methods of giving instruction and of advertising the scheme, and these were again put in force vigorously. The general results are not yet known. Precise statistics of the numbers of rats killed cannot unfortunately ever be obtained, but there is every reason to believe that the "kill" far exceeded that of previous special campaigns.

Some statistics of the work of 1920 can, however, be given. During the month of January 120,000 rats were destroyed in Monmouth, and 140,000 in Somerset. After the fumigation of a ship on arrival at the port of London 1,466 dead rats were picked up—a sufficient testimony to the menace which rat-infested vessels present to the country. In Dover 16,000 rats were killed and 18,000 caught on bird lime during twelve months. On Foulness Island 7,000 rats were killed during six months, and in the same place the Ministry's Technical Adviser and his assistants, acting on behalf of the Army Authorities who own the Island, cleared the rats from the sea walls. In Gloucester 356 parishes were treated during January of last year, with a consequent very effective clearance. The London and North Western Railway Company have appointed an officer to superintend destructive work over the whole of their system. This official has had the advice of the Ministry's Technical Adviser. Part of his work has been the treatment of the Birmingham area, which he did at a cost of £9. It is instructive to note in this connection that last year treatment of the same area by virus cost the Company £217. Of one hundred railway stations treated as the Ministry's experts directed, 96 were successfully cleared and 2 partially cleared, while 2 attempts unfortunately proved failures. The causes of failure were, however, investigated; the treatment was repeated, and the result was a complete success.

This review can give only a brief account of what has been accomplished in less than two years. Although progress is undeniably remarkable, much more remains to be done to reduce the rat population to such small dimensions that neither the health nor the wealth of the community shall suffer longer from this pest.

IMPROVEMENT OF GRASS LAND :

THE IMPORTANCE OF EXPERIMENTS.*

T. J. JENKIN, M.Sc.,

The University College of Wales, Aberystwyth.

It should be clearly understood that the campaign for the improvement of grass land instituted by the Ministry does not aim at converting arable into pasture land. The object is so to improve existing pastures and any new pastures which must be laid down, either temporarily or permanently, that with the desired extension of the arable area, the amount of grass will at least not be diminished but will even be increased. It is therefore intended that the improvement should not be limited to obviously poor old pastures, but should extend to all classes of grass land which are capable of improvement by any method.

The Value of Experiments.—Our present information with regard to pastures is very largely based upon results obtained by means of experiments in various parts of the country. The conditions under which these have been carried out vary a great deal, and one can never be quite sure that if an experiment which has been carried out in one part of the country is repeated in another part, where the conditions are more or less different, the results obtained will be exactly similar. This, however, does not mean that such experiments are of but little value. They have proved to be of great value in many cases, and have already led to a very great improvement, and results obtained in one district have been reproduced in other distant localities.

Manuring for Meadow Hay.—Methods of manuring for meadow hay vary considerably, and many are based on very long practice. This, however, does not prove that they are the best possible. It may be that an improved method would produce either greater quantity, or better quality, or, what is chiefly to be aimed at, an improvement in both quantity and quality.

The case of water meadows is obviously one where a great deal of information might be obtained by means of well-conducted experiments. At the present time farmers are faced with the difficulty of cost, both of upkeep and of haymaking, and a system, therefore, which would reduce expenditure and at the same time

* Abstract of a lecture delivered by Mr. T. J. Jenkin at a meeting of the Farmers' Union at Dorchester, 25th September, 1920.

as basic slag, while when added to basic slag it gave no increase over the basic slag alone.

With another seed mixture the three forms of treatment gave results almost identical with the above in the first year's hay crop.

This experiment was continued for many years, the manuring being repeated every third year. The average annual results for eleven years were as follows:—

	<i>Seed Mixture A.</i>	<i>Seed Mixture B.</i>
Plot 1.	23½ cwt.	34 cwt.
" 2.	22½ "	30½ "
" 3.	25 "	33½ "
" 4.	5½ "	9½ "

A and B differed from each other only in the fact that seed mixture B contained 4 lb. per acre of wild white clover seed in addition to the seeds included in A.

These results obtained over a period of eleven years are doubly interesting, as they show the effects both of proper manuring and also the great difference obtained by the use of two different seed mixtures.

In the case of seed mixture A, there was a difference of 19½ cwt. per acre per annum, on the average of eleven years, between the no manure plot and Plot 3. and in the case of seed mixture B, a difference of 24½ cwt. per acre per annum between the unmanured plot and Plot 1. but the differences between the manured plots were relatively small. The average difference of 9½ cwt. per acre is, however, not negligible, and the fact that the combined dressing of farmyard manure and basic slag did not give very appreciable increases over the plots on which each was used separately is important.

The Importance of the Seed Mixture.—The above experiments emphasise the importance of using the best seed mixture. In the first year's hay crop, there was very little difference between mixtures A and B where basic slag had been used, but the addition of 4 lb. per acre of wild white clover seed resulted in an increase of 9½ cwt. of hay per acre with farmyard manure, and an increase of 11½ cwt. per acre with no manure. Over the eleven years the 4 lb. per acre of wild white clover gave a handsome profit, equal to £4 7s. per acre per annum on the basic slag plots at present prices of slag and wild white clover. Much smaller quantities of wild white clover than 4 lb. are quite effective with proper manuring.

Experiments carried out in North Wales and elsewhere also prove the great superiority of wild white clover seed over ordinary white Dutch clover seed in the forma-

tion of permanent pastures. In some of the North Wales experiments this superiority was often clearly seen in the thicker sole of the pasture, even in the first year.

The question of white clover is obviously very important, not only in the formation of long duration pastures but even for short duration leys, as a good development of white clover in the pasture has a beneficial effect on the subsequent arable crops.

In the formation of a pasture, however, the seed mixture as a whole and the purpose for which it is intended must be taken into consideration. Seed mixtures should be designed according to the length of time the field is to be in grass and the type of soil. There are also other factors of great importance, such as the local conditions, especially altitude and climate, which need to be taken into account.

With seed mixtures for pastures of several years' duration, the problem is more complicated than in the case of short duration pastures, and in considering the question of permanent pastures the difficult period which is usually encountered between the third and the seventh years has to be considered.

The Treatment of Established Pastures.—In the formation of a permanent pasture the seed mixture is very important, although by no means all-important. On second-rate and poorer land at least, the effects of a good seed mixture can easily be destroyed by unsuitable and ungenerous treatment, while it is also true that a good pasture may ultimately be obtained by generous and careful treatment, where a relatively poor seed mixture has been used. In the latter case, however, the land does not produce its maximum over a number of years, while in the former case it hardly ever is given a chance to do so. It is very important that these pastures which are really "in the making" should be carefully managed as regards drainage, manuring, grazing, or mowing, so that they may not reach the exhausted state in which wide areas in this country are found at the present time.

Much of our semi-derelict grass land might have been much more easily saved by better treatment in the past, but it is not yet too late to mend.

Experiments in North Wales have also shown that much very poor grass land of various kinds—on peat, on thin hill loams, and on heavier soils—which had never been treated in any way, is capable of great improvement, and, generally speaking, in these experiments ground mineral phosphate and basic slag were about equally successful.

AGRICULTURE AS AN OCCUPATION FOR WOMEN.

GERTRUDE WATKIN.

EXPERIENCE gained during the Great War has made it necessary for us to reconstruct somewhat our ideas of what are, or what are not, possible occupations for women, and this applies in a greater degree to agriculture than to any other occupation.

Dairy work and poultry keeping have probably always been regarded as coming within the woman's sphere of usefulness. Except in these two special branches, however, the skilled work on a farm was in the past considered to be essentially a man's work, at any rate in England, though women were employed for unskilled and seasonal work. During a long period women worked in gangs at almost nominal wages and under very bad conditions at such jobs as stone-picking, and most of us are familiar with the sight of train loads of hop-pickers, pea-pickers and fruit-pickers leaving London and other great centres when the season comes round for the respective crops to be gathered.

When, some quarter of a century ago, the Horticultural College at Swanley opened its doors to women students, many heads were shaken and much laughter was provoked by the idea of women taking up gardening as a profession. At first there was some difficulty in finding posts for the women at the close of their training, but as time passed on and their efficiency became recognised, this difficulty gradually disappeared, and gardening was commonly accepted as being enjoyable, light work suitable to a woman's strength. While agreeing with the main conclusion as to women's capacity as gardeners, one wondered sometimes whether those who described it by the adjective "light" had ever done a really hard day's work in the garden.

A few rash souls of the weaker sex were then heard to say that, not content with the spade and the hoe, they wanted to take to the plough, the harrow, and farming generally, without limiting themselves to the dairy and the chicken-run. This was an innovation, indeed. "How could a woman farm?" was asked, incredulously. "Why, she couldn't carry a sack of wheat!" It was futile to suggest that farming does not consist entirely of carrying sacks of wheat, and, further, that there are many farmers and farm hands of the opposite sex who are also unable to perform that particular task. The argument was felt to be conclusive, backed up as it was by the thought in many peoples' minds that farming was "not quite nice" for women.

The day came, however, when our able-bodied men were called away to a grimmer task than carrying sacks of wheat, and the country was faced with the necessity of producing the last possible ounce of food in our own land. It then became obvious that if agriculture was to "carry on" under these conditions, it must rely very largely upon the help of women. Passing over the work of the Land Army, which has already been dealt with by those better qualified to write of it, I would only point out that the women of the Land Army proved that there is no branch of agriculture that *some* women, at any rate, cannot perform. Whether it is desirable that women should work regularly, under normal conditions, at certain classes of farm work is, however, open to question.

Let us first consider the wage-earners on a farm and their various duties. Among the cattle, a woman certainly should be, and almost invariably is, quieter and gentler than a man, and I think many farmers would agree that young stock thrive best under the management of a woman. Fattening stock, too, have in many cases been found to do better when looked after by women than by men. On the other hand, horse and tractor work is unquestionably beyond the strength of the average woman, and should, therefore, be left in the hands of men. Field work, such as hoeing, singling, docking, &c., can be done efficiently by women. It is not desirable, however, that women should perform such work with men, they should work in a separate group or gang, for a man's greater strength enables him to work faster than a woman, who is apt to scamp her work in order to keep up the pace, or else a man slackens off to the slower pace of the woman and is thus not worth the higher wages he receives.

Regarding the question whether agriculture offers a satisfactory opening for the woman with a little capital, there appears to be no reason why a woman should not succeed in any branch of farming, provided that she means to make it the one real interest and aim of her life. She should find out how best she can fit herself for her chosen profession, and which branch of farming she is most suitable for. She should also find time to read the current agricultural literature. It is useless to imagine that anyone can play at farming and also make a success of it. The woman who wants to potter about her farm in the morning, play tennis or golf in the afternoon, and spend a few hours at the bridge table in the evening, would be well advised to leave the land alone, for the farmer's hand and eye must be everywhere if success is to be achieved.

My advice to the girl who aspires to become a farmer is to spend *at least* two years as a working pupil under a good farmer or farmers. Experience on more than one farm is desirable, for thereby she would be enabled to study a variety of farming methods. She would then be in a position to get the very best out of a College course, for which she should enter, working for the National Diploma of Agriculture or for a degree in agricultural science. The mistake of going direct to the College without any practical experience is often made, the student not knowing which particular branch of the subject she wishes to give most attention, and much valuable time is wasted in learning those elementary details of practical work with which she should have been already familiar.

If we assume that our student left school at seventeen or eighteen, the course of study suggested above will end when she is about twenty-three years of age, and she will be still too young to undertake the responsibility of a farm. A wiser course would be to obtain a post as forewoman or assistant on a farm, and so continue to lay up a store of experience that will prove invaluable when, as so frequently happens on a farm, things occur which defy the rules of the text-books. There is probably no occupation in the world in which experience is of such vital importance as in agriculture, and it is to this lack of experience in our college-bred agriculturists that the wide-spread distrust of the farmer for the man or woman with the Diploma or Degree is to be attributed. On this point, it is necessary to be very clear and to remove any suspicion that in this article it is intended to belittle the value of a college training. I am convinced that a thorough knowledge of the theory and science of agriculture is of the highest value to the farmer, but the college course should be preceded by an equally thorough training in the practical details of the work. Average farmers may not plough, milk, care for the horses in the stable, and drive the tractor on the farm, but unless they *can* do so, if necessary, and are capable of showing by practical demonstration how a job should be done or where a fault lies, they will be less well served than their neighbour, who, though ignorant of science, knows exactly from experience the details of farm work.

A branch of agriculture in which a few women are already employed, and which should offer a field for the energies of a certain number in the future, is research work. For this, a degree in agricultural science, and a special aptitude for the work.

are essential. I venture to think, however, that if our experimental farms and research stations are to be of the utmost value to the community, the workers therein should have spent a preliminary period of two years obtaining a practical knowledge of ordinary farm work.

Finally, there is the work of the teacher. We have not yet got an Agricultural College for women such as we have in one or two places for Horticulture, but the future may see this hope realised. Meanwhile, women are employed as teachers in dairy and poultry work at various Farm Institutes, and also, in some cases, as travelling teachers under County Councils and in other ways. Here again it is above all things necessary that the teacher should have had thorough practical experience of the daily work of a commercial poultry or dairy farm, in order that the teaching given may be such as it is possible for the pupils to carry out in their everyday life.

NOTES ON MANURES FOR FEBRUARY.

E. J. RUSSELL, D.Sc., F.R.S.,

Rothamsted Experimental Station, Harpenden, Herts.

The Return from Spring Dressings of Nitrogenous Fertilisers.—In these notes emphasis has repeatedly been laid on the necessity for applying spring dressings of nitrogenous fertilisers to cereals. A demonstration on the large scale was arranged last season on wheat on Great Harpenden Field, Rothamsted, the results of which show the returns obtainable. The wheat had been preceded by a wheat crop, and this by oats; the land, however, had been given a good bastard fallowing during the fine weather of 1919, and weeds had been fairly well cleared away. The results were:—

	Control	<i>Single Dressing of Sulphate of Ammonia (100 lb per acre).</i>		
		Applied early, Feb 10th, 1920.	Applied March 6th.	Applied late, May 10 h.
Dressed Grain, bush per acre	28.9	28.7	29.8	31.6
Increase on manured plots	—	Nil	0.9	2.7
Wt. per bush dressed grain	63.9	63.6	63.8	62.7
Proportion of offal grain to 100 of dressed grain	6.4	6.3	6.9	13.5
Straw, cwt. per acre ...	24.2	26.9	31.1	33.6
Increase on manured plots	—	2.7	6.9	9.4

	Control	<i>Double Dressing of Sulphate of Ammonia (200 lb per acre)</i>		
		Applied early, Feb. 10th, 1920.	Applied late, May 10th, 1920.	
Dressed grain, bush. per acre	28.9	35.9		32.6
Increase on manured plots	—	7.0		3.7
Wt. per bush. dressed grain	63.9	63.6		62.7
Proportion of offal grain to 100 of dressed grain	6.4	6.5		15.7
Straw, cwt. per acre ...	24.2	35.9		36.9
Increase on manured plots	—	11.7		12.7

The single dressing of sulphate of ammonia (100 lb. per acre) would be regarded by many farmers as the utmost that could safely be applied, and yet the double dressing (200 lb. per acre) has proved distinctly more profitable. At its best the single dressing gave an increase of less than 3 bushels of grain and 9 cwt. of straw per acre, and when applied at the usual time and in the usual way it gave an increase just under 1 bushel of grain and 7 cwt. of straw per acre. Even at present prices the financial return is a good one.

The field is being put into wheat again for the third time, and the double dressing is being given over practically the whole area.

The experiment is further interesting as showing the influence of the time of applying spring dressings. The single dressing gave no increase of grain and only a small increase of straw (2 $\frac{3}{4}$ cwt.) when applied in February, a larger return when applied in March (just under 1 bushel of grain and 7 cwt. of straw per acre), and a still larger return (2 $\frac{3}{4}$ bushels of grain and 9 $\frac{1}{2}$ cwt. of straw) when applied in May. This high return from the late application was not expected and was probably associated with the cold dry spring following on the wet spell in April. The returns from the double dressed plot show that the late application cannot be relied on to prove satisfactory; the February dressing gave an increase of 7 bushels of grain and 11 $\frac{3}{4}$ cwt. of straw, while the May dressing gave only an additional 3 $\frac{3}{4}$ bushels of grain, though the increase in the straw was 12 $\frac{3}{4}$ cwt. per acre. The appearance of the plots, however, showed the danger of the late application; the leaves were dark green in colour and looked very unhealthy. Had there been much rust they would probably have suffered considerably, and in a season more conducive to growth the crop would almost certainly have lodged badly. No farmer liked the look of this plot and it was saved only by the special character of the season. The weight per bushel of the grain shows a small and probably real falling off as compared with the crop receiving the earlier applications; but the proportion of offal grain to 100 of dressed grain shows a substantial rise. Where the manures were applied early the proportion was about 6 $\frac{1}{2}$ per cent., and it was the same whether the single or double dressing was used—further proof that the double dressing is not excessive. When, however, the manures were applied late the proportion rose to 15.7 per cent. in the case of the double dressing, and only little less, viz., 13.5 per cent., in the case of the single dressing.

The returns from spring dressings are seen to depend very much on the time of application, but season plays so large a part that it is impossible to foretell what the result will be. Where only a small dressing is being given it may prove more effective if applied rather late, but if a larger return is sought and a larger dressing given, early application is essential and late application is highly speculative.

Nitrate of Soda or Sulphate of Ammonia for Spring Dressings of Cereals.—Now that nitrate of soda is again obtainable several correspondents are asking which is preferable as spring dressing for cereals. There is usually not a great deal to choose between them when comparison is made on the basis of equal nitrogen content. (Sulphate of ammonia contains 20 per cent. of nitrogen, while nitrate of soda contains about 16 per cent.)

On medium or light soils fairly well supplied with lime nitrate of soda is about 5 per cent. better than sulphate of ammonia containing the same amount of nitrogen. On chalk soils the difference is less or disappears altogether. On heavy soils the balance is in favour of sulphate of ammonia, since nitrate of soda is apt to bring the soil into a sticky condition which, while not as harmful for cereals as for roots, is nevertheless undesirable. On soils inclined to be sour the advantage lies with nitrate of soda, since sulphate of ammonia on sour land may cause considerable damage to the crop, especially to young seeds sown in the corn, while nitrate of soda tends to counteract the injurious effect of acidity.

Improvement of Rough Pasture.—Farmers in hill and moorland districts commonly have large areas of rough pasture which affords little subsistence to their animals. So long as it is unenclosed very little improvement is possible, but something can be done as soon as fencing can be erected. It is often supposed that a dressing of lime is the proper means of improvement, and this practice is followed in many parts of the country. Experiment has shown that lime is frequently not the best ameliorating agent; basic slag or mineral phosphate is often much better.

An interesting set of trials in North Wales* gave the following results :—

On Wet Acid Peat, by far the commonest in North Wales and no doubt in other wet hill regions also, the effect of manure was :—

1. Small where the herbage is mainly *Molinia* (Purple Heath Grass).

* Univ. Coll., N. Wales, Bangor, Repts. on Expts., 1917—1919.

2. More marked where the herbage was varied and included other grasses.

In this case phosphates led to a marked improvement, basic slag and Gafsa phosphate being equally effective; potash had less effect, as also had lime and limestone, except when used in conjunction with superphosphate.

On fairly Well Drained Acid Peat and on Neutral Peat (neither of which, however, is common), a marked improvement was effected by basic slag, although neither lime nor limestone was of much use.

The trials bring out the interesting point that farmers cannot always rely upon lime to improve poor grass land, even if it is wet and acid. This is not peculiar to North Wales. A similar result has been obtained on the poor clay soils in the eastern half of England, in regions as widely separated as Essex and Northumberland. As a general rule basic slag or mineral phosphate is more useful than lime on grass land; but the rule is not without exceptions. There are in Yorkshire considerable areas of light loam overlying and derived from Coal Measures sandstone which carry poor herbage when in grass, for which the old idea is more correct; lime has a marked beneficial effect, greater it is claimed* than that of basic slag.

The Garforth experiments show that lime is often effective on poor grass land, the results in cwt. per acre being:—

Plot.	Treatment.	Initial difference in favour of S half, unlimed.	Average 1912-1919 (8 yrs.)		
			S. half, unlimed.	N. half, limed.	Increase, presumably due to lime.
1	Unmanured	5½	17½	24½	12½
2	Dung every year	2½	41½	38	1½
6	Dung and complete artificial, alternate years	1½	38½	38½	1½
7	Complete artificial every year	4½	27½	30½	7½

It is widely recognised, however, that directly sour grass is ploughed out for arable crops it must be adequately treated with lime. Farmers breaking up leys of 8 or more years' duration may lose much of the benefit of the accumulated fertility unless

* J. A. Hanley, Leeds Bull., No. 115, 1920.

they do so. One Table from Dr. Hanley's report shows this very well, the difference between "sour" grass land and "chalked" grass land as preparation for arable crops:—

Wheat (Grain and Straw) per acre obtained in 1919 from Experimental Plots on Old Pasture ploughed out in 1918.

No of Plot.	Treatment in 1898 whilst under grass (pasture)	Northern halves of plots, Chalked 1911.		Southern halves of plots, No chalk.	
		Grain bush	Straw cwt	Grain bush	Straw cwt
1	Homo				
2	Fine Rape Meal				
3	Coarse Rape Meal . . .				
4	Dung				
8†	Fine Bone Meal, Kamit, Nitrate of Soda .. .				
9	No manure				
10†	Slag, Kamit, Nitrate of Soda				
14†	Quick-lime				
15†	Gas-lime				
		Grain bush	Straw cwt	Grain bush	Straw cwt
		40½	22½	10½	8½
		38	21½	19½	14½
		29½	16½	27	15½
		27½	19	15½	11
		24½	14	23½	1½
		40½	26½	29½	18
		25	16½	22	12½

* These three grass plots were merged into one for the purpose of the wheat experiment.

† 1½ cwt. Nitrate of Soda per acre supplied annually 1899 to 1917 to both N. & S. halves of these plots.

† 6 tons per acre in 1898 to South halves, 3 tons per acre to North halves.

FEEDING STUFFS IN FEBRUARY.

E. T. HALNAN, M.A.,

Ministry of Agriculture and Fisheries.

At the request of a correspondent, the feeding value of linseed has been included in the table and the consuming value of vetch and oat silage has been added. It may be well to emphasise the fact that the consuming values given for potatoes, swedes, mangolds and silage have no relation to the market value, but have been worked out on the basis of their nutritive values. That is to say, if a farmer feeds his potatoes to pigs, he is actually receiving £8 5s. per ton for them, but if he can sell the potatoes at a price well in advance of this, it will be more profitable to dispose of them and purchase other feeding stuffs such as maize or maize meal. Of course, this argument is limited by the fact that roots cannot be regarded as strictly interchangeable with other feeding stuffs, and a certain amount of roots will have to be retained on the farm in any case in order to fit in with the feeding system adopted. The cost of carriage and marketing will also have to be taken into consideration. The consuming values quoted, however, are a guide to the farmer in dealing with his surplus roots, if a market is available.

In some cases, apparently, silage has been found to have a constipating effect on live stock, but to correct this tendency a certain amount of linseed or linseed cake has been given. It would be interesting to learn whether farmers generally have found that silage has such an effect on live stock, or whether it is peculiar to a particular district or class of silage. Any information on this point from readers of the *Journal* would be welcome.

It will be noticed by reference to the table that linseed is more economical to buy as a feeding stuff than linseed cake, and that it is more profitable to consume home-grown linseed than to sell it and buy linseed cake. The chief points to bear in mind with linseed are (a) that it contains a considerable proportion of oil, 36 per cent., as compared with 8 to 9 per cent. in linseed cake, and (b) that it is desirable to grind linseed. As a general rule the farmer should be able to grind linseed without difficulty, but if there should be a tendency to clog the machine, it should

NAME.	Price per Qr.		Price per Ton.	Manurial Value per Ton.	Food Value per Ton.		Starch Equiv. per 100 lb.	Price per Unit, Starch Equiv.		Price per lb. Starch Equiv.
	s.	lb.	£ s.	£ s.	£ s.	£ s.	s.	s.	d.	d.
Barley, English Feeding	58/-	400	16 5	1 6	14 19	71	4/2			2.23
" Foreign "	60/-	400	16 16	1 6	15 10	71	4/4			2.32
Oats, English "	52/-	336	17 7	1 9	15 14	59.5	5/4			2.86
" Foreign "	41/6	320	14 10	1 9	13 1	59.5	4/5			2.37
Maize "	61/-	480	14 5	1 5	18 0	81	3/2			1.70
Beans, English spring										
" winter "	70/-	532	14 15	3 1	11 14	66	3/7			1.94
" Chinese "	15/8	112	15 5	3 1	12 4	66	3/8			1.96
Pears, English blue	71/-	504	15 15	2 13	13 2	69	3/9			2.01
" dun "	80/-	504	17 16	2 13	15 3	69	4/5			2.37
" maple "	85/-	504	18 18	2 13	16 5	69	4/8			2.5
" Japanese* "	125/-	—	27 16	2 13	25 3	69	7/3			3.88
Buckwheat "										
Rye, English "	76/3	480	17 16	1 8	16 8	72	4/7			2.45
Millers' offals—Bran			13 10	2 10	11 0	45	4/11			2.63
" " Coarse middlings			14 10	2 10	12 0	64	3/9			2.01
Barley meal "			20 0	1 6	18 14	71	5/3			2.81
Maize* " "			15 10	1 5	14 5	81	3/6			1.87
Bean " "			18 15	3 1	15 14	66	4/9			2.54
Fish* " "			26 0	7 12	18 8	63	6/11			3.70
Linseed " "			23 5	2 16	20 9	119	3/5			1.83
Cakes, Linseed "			18 0	3 12	11 8	74	3/11			2.10
" Soya " "										
" Cotton seed "			11 10	3 5	5 5	42	3 11			2.10
" Cotton seed decorticated			19 0	5 6	13 14	71	3 10			2.05
" " decorticated meal*			17 0	5 6	11 14	71	3/3			1.74
Coconut cake "			13 10	3 0	10 10	79	2/8			1.43
Groundnut cake "			14 5	3 9	10 16	57	3/9			2.01
" decorticated "			17 10	5 5	12 5	73	3/4			1.78
Palm kernel cake*			8 0	2 1	5 19	75	1/7			0.85
" meal "			6 0	2 1	3 19	75	1/1			0.58
Brewers' grains, dry			9 5	2 7	6 18	49	2/10			1.52
" wet "			1 14	0 12	1 2	15	1/6			0.80
Distillers' " dry			11 15	2 16	8 19	57	3/2			1.70
" wet "										
Malt culms "			9 10	3 6	6 4	43	2 11			1.56
Potatoes †			3 5	0 8	2 17	18	3/2			1.70
Swedes †			1 7	0 5	1 2	7	3/2			1.70
Mangold †			1 5	0 6	0 19	6	3/2			1.70
Ve'ch and oat silage †			3 9	0 15	2 14	14	3/2			1.70

* Prices at Liverpool.

† Consuming value.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in the larger markets, usually London, and refer to the price ex mill or store. They are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is £2 1s. per ton. The food value per ton is therefore £13 19s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 1d. Dividing this again by 23.4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1.11d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

be mixed with maize meal in the proportion of 1 part of maize meal to 7 parts of linseed.

Considerable quantities of beans which, during the late War, would have been intended for human consumption, are now being marketed as food for live stock. Several correspondents have written as to the value of haricot beans, Rangoon beans and butter beans for feeding to live stock. Samples of "Rangoon beans" and "haricot beans" submitted to the Ministry are apparently the same feeding stuff, and indicate differences in trade terms. Haricot beans and butter beans have a similar composition, but butter beans contain rather more oil, namely, 2 per cent., as against 1.8 per cent. in the case of haricot beans. In composition and feeding value, these beans resemble peas, and may be fed under all conditions where peas are used, and to the same extent, but it is advisable to soak them thoroughly in water before using. Meal prepared from these beans should prove quite suitable for pigs if well soaked in water before using. Very little information is available as to the practical points to be observed in the feeding of these beans to live stock, but there is no reason to anticipate difficulty in this matter, provided that reasonable care is exercised in their introduction into the diet.*

Palm kernel cake, at its present price is an extraordinarily cheap feeding stuff. It can be used for most stock purposes, and is valuable for milch cows and pigs.

* Information on the poisonous character of certain forms of the beans of *Phaseolus lunatus* (which covers Java, Rangoon, Lima and other beans) has been given in this *Journal* from time to time, notably p. 562, Vol. XXV., 1918.

AGRICULTURE ABROAD.

LIVE STOCK EXHIBITION IN ARGENTINA—EXPORTS OF PRODUCE FROM DENMARK—WART DISEASE OF POTATOES ON THE CONTINENT.

THE high place which British breeds of live stock occupy in the estimation of Argentine stock rearers is well shown by the opinions expressed of British classes of animals entered at the **International Live Stock Exhibition** held at Buenos Aires in the Argentine. under the auspices of the Argentine Rural Society in September last. The Society holds an Exhibition every year, and it is significant that many of the breeders and stock raisers of the Argentine who enter animals have for a number of years past made purchases of British pedigree stock with which to improve their native strains.

It has been the practice of the Argentine Rural Society for some years to invite the Royal Agricultural Society of England to appoint judges to adjudicate on several of the classes of live stock exhibited. In the case of the Exhibition recently held British experts were chosen to judge the Shorthorn, Hereford and Aberdeen-Angus cattle, the Suffolk Punch, Shire and Clydesdale horses, the Longwool and Blackfaced sheep, and the pigs. There was a general agreement of opinion that the Shorthorns were of excellent standard, both as regards size and quality, and the Shorthorn grand champion bull was sold for a record price. The number of Herefords exhibited was not large, but the champion was spoken of as a perfect model of the breed. The Aberdeen-Angus class was declared to be above expectation, and one of the judges remarked that the propaganda in favour of this breed during the last few years appeared to have done much to draw attention to its merits and the value of its meat. With regard to the sheep, it was considered that the breeds generally should be improved and efforts made to develop the size of the animals. The judges referred to the pigs as being, with few exceptions, of somewhat ordinary breeding. Among the Berkshires there were a number of first-class animals.

One feature of the Exhibition which is worthy of note was the considerable interest shown in an exhibit of seven bulls and nine cows of Holstein-Friesian cattle which were imported from the United States expressly for the Exhibition, and which

realised good prices at the sale. There appears to be no doubt that if in future British breeders wish to take advantage of the increasing interest which is shown in the Argentine for pedigree dairy cattle, they will have to be prepared to face an energetic competition from North America.

* * * * *

DENMARK, in common with most European countries, felt the pressure of war conditions in the matter of the home production

Exports of Agricultural Produce from Denmark.

of food, with serious consequences to her export trade. The factors which contributed to this decline are briefly set out in a Report on the Post-War Economic and Industrial Situation in Denmark, issued some months ago.*

It is pointed out that during the last generation and a half, Denmark has devoted herself principally to food production on scientific lines. A high stage of development has been reached in this direction by the assistance of the State in establishing agricultural schools and associations, and by the growth of the co-operative movement, which has been such a distinctive feature in Danish agriculture.

Before the War, Danish exports of agricultural produce to Great Britain in the form of animal substances were of considerable importance. The magnitude of this trade will be realised from the imports into the United Kingdom of butter, bacon and eggs in 1914, which were respectively 44 per cent., 55 per cent., and 24 per cent. of the total quantities imported. During the early part of the War, Denmark increased her export trade to Great Britain, but a decline afterwards set in, largely owing to the more attractive prices offered by Germany, who was beginning to feel the effects of war conditions.

As time went on, however, Denmark was compelled materially to reduce her exports. In normal times it had been her practice to consume margarine to a large extent instead of butter, which was a profitable item of export. The available supplies of margarine, however, were much reduced during the War. Moreover, the restrictions on the importation of feeding stuffs and fertilisers made the production of meat and dairy produce on a pre-war scale impossible. Every effort was made to meet the situation by increasing the area under crops, but bad harvests in 1916 and 1917 accentuated the difficulties, and a drastic reduction in the number of live stock

* C.M.D.955, 1920. Obtainable from H.M. Stationery Office, Imperial House, Kingsway, London, W.C.2, price 4d. net

kept had to be made, particularly in the case of pigs. Exports as a result, ceased entirely.

The trade has not since recovered its former place in the European markets. This has been largely owing to restrictions in shipping, the depreciation of the currency in neighbouring countries, and the high prices ruling for feeding stuffs. Her former trade with England has especially suffered. The lower prices for feeding stuffs obtaining in this country have been an influential factor in preventing a resumption of the export trade of butter and bacon on the pre-war scale, and, as a result, in default of the usual British market, the Danes have sought other markets for the disposal of their surplus products.

Farmers would be well advised to improve their markets in bacon, dairy produce and eggs, in order that, as pre-war conditions gradually readjust themselves, they may be able the more successfully to compete with Danish produce.

* * * * *

THE following summary regarding the prevalence of Wart Disease of potatoes (*Synchytrium endobioticum* Perc.) in Europe, as well as the measures of control in the various countries, has been compiled from the publications of the International Agricultural Institute at Rome, and is supplemented by a report prepared by one of the Ministry's Inspectors who recently visited the Continent.

**Wart Disease of
Potatoes :
Prevalence on
the Continent :
Methods of Control.**

Holland.—Wart Disease has been discovered in the neighbourhood of Winschoten, near Groningen, in the north-east of Holland, where there are a few isolated cases. It is believed that the disease was introduced from Germany in infected potatoes carried by workmen. The Phytopathological Service of Holland keeps a sharp look-out for the disease, and the planting of potatoes in affected districts is prohibited. Experiments made with the object of discovering a cure failed. One Dutch variety—Ceres—was found to be immune, but it is not a very good cropper. Experiments are being continued with a number of English varieties. A Ministerial Decree of 20th March, 1914, ordered the inspection of potatoes destined for export to the United States of America. By a Decree of 18th July, 1914, the importation and transit of potatoes from certain countries may be forbidden, or only provisional admission granted. A Decree of 7th September, 1920, governs the importation and transit of

potatoes from Great Britain. Such consignments are to be in clean bags, sealed by an inspector of the Department of Agriculture, and must be accompanied by a certificate that they were grown on land free from Wart Disease.

Denmark.—So far, Wart Disease has not been observed, although many tons of potatoes have been examined. The Phytopathological Experiment Station of Denmark issues monthly bulletins on plant diseases and the methods of control, while numerous Agricultural Societies occupy themselves with the production of the best varieties of cereals, and, above all, of those potatoes which are recognised as being immune to disease. Fields devoted to such cultures are subject to rigorous control in order to guarantee the absolute immunity of the products, which are sold cheaply to members of the Societies. An Order of 28th January, 1876, prohibits the importation from America of potatoes and potato waste as well as the containers in which they are packed. By an Order of 19th February, 1914, arrangements were made for potatoes destined for the United States of America to be inspected. Arrangements have also been made with the Customs and Railway Authorities for at once reporting to the Inspection Committee the importation of potatoes from abroad.

Germany.—In Germany, Wart Disease is found in the Rhine District, especially south of Cologne, and also in the Hamburg District and in Holstein. Elsewhere, there are scattered cases, but only in the Rhine Provinces are fields attacked. In the greater part of Germany, immune varieties only are allowed to be grown where disease is present. Included in the so-called immune varieties, however, are some known to be susceptible to the disease, the reason being the difficulty experienced in obtaining adequate supplies of true immunes. Occupiers of land are required to produce seedmen's receipts for the varieties grown, and Inspectors visit infected or suspected areas and give helpful advice. Steps are being taken in the Hamburg District to issue an order making compulsory the notification of the disease and the planting of immune varieties only. No general law applicable to the German Empire as a whole exists in regard to plant diseases in general, though the matter is now under consideration. Measures against certain insects or cryptogamic diseases are embodied in laws and regulations issued by the Central Government or by the Governments of the different States in accordance with the needs of the moment. Experiments in soil disinfection at Niederpleis and elsewhere with a

series of chemicals did not give satisfaction in every respect. Dormant spores were found (1920) to retain their vitality in the soil for at least 10 years.

Norway.—In 1914, Wart Disease appeared in the Kristiansand District in two localities near Grimsmoen, and by order of the Department of Agriculture the infected plants were immediately uprooted and the soil disinfected with a 1 per cent. formalin solution, while it was strictly forbidden to plant potatoes or tomatoes in the infected zone for at least 6 years. In spite of these precautions, the disease spread in 1915 and was reported from 27 other localities. The Government spared no effort to suppress the pest. It gave special facilities for the purchase of disinfectants, it held lectures and distributed pamphlets, and, finally, it issued the Decree of 8th September, 1916, which, besides regulating the control of the disease, imposed penalties on those farmers who, instead of co-operating with the State, attempted to evade the law.

Sweden.—The disease has been reported by Eriksson as occurring near Stockholm.

Austria and Russian-Poland.—It was stated in 1920 that Wart Disease had not appeared in Austria, but was established in Russian-Poland.

France.—In "Annales du Service Epiphyties," Vol. IV, 1915, it is stated that Wart Disease does not occur in France. By a Decree of 19th December, 1910, the import of potatoes affected with "Black Scab" is prohibited.

Belgium.—Apparently the disease has not yet been recorded officially in Belgium, but there is every possibility of its existence in small gardens, as an officer of the Ministry whilst serving in Belgium during the War noted its presence near Ypres. There are no regulations dealing with it, but the nearness of centres of infection induced the Authorities to warn farmers of the serious nature of the disease.

Luxembourg.—Mr. Bintner, of the Agricultural Department of Luxembourg, told an official of the Ministry of the widespread nature of Wart Disease there.

There appear to be no definite records of its appearance in other European countries, nor indeed in other parts of the world save in the U.S.A. where it was introduced from Europe in 1912, but remained unrecorded until 1918.

THE Ministry desires to bring to the notice of fruit growers the serious nature of Silver Leaf Disease and the obligations placed upon them under the Silver Leaf Order of 1919.

Silvery leaves on a plum tree generally indicate that the tree is suffering from Silver Leaf Disease. If one or two branches only are affected, these should be removed and burnt. The branches must be cut back to a point where no dark stain in the wood can be found, and, if practicable, close to the main branch or stem.

When affected branches die, the fungus spreads out through the bark, and forms flat crusts or bracket-shaped bodies, on which are produced innumerable spores which spread disease. The annual loss to growers through the disease is already very considerable.

By the terms of the Silver Leaf Order of 1919, growers must grub up and burn all dead plum trees, and cut away and burn all dead wood from plum trees, before the 1st April of each year, under penalty for neglect.

Full particulars of the disease and suggested measures of control were given in an article published in the issue of this *Journal* for May, 1919, p. 162, and are also contained in Leaflet No. 802. Copies of the latter may be obtained post free on application to the Offices of the Ministry, Whitehall Place, London, S.W.1.

A PRELIMINARY statement has recently been issued by the Ministry showing the estimated total produce and yield per acre of the potato and root crops in England and Wales in the year 1920, with comparisons for 1919, and the average yield per acre of the ten years 1910-1919.

It is stated that potatoes were planted late as a rule, owing to the unfavourable weather of April, and the crop did not develop well on heavy land during the cold sunless summer. The tubers are therefore small in many districts and yields were reduced appreciably by disease in the south-west. The yield per acre over the whole of England and Wales is estimated at 5.8 tons, which is two-fifths of a ton below the average of the 10 years 1910-19, and practically the same as in 1919. Generally speaking crops were somewhat above average in the eastern half of the country but

considerably below in the west, the yield in the south-western counties being estimated at only 3.8 tons per acre, whilst in Lancashire only about two-thirds of an average crop was obtained. Owing to the large area, however, the total production, 3,137,000 tons, is 400,000 tons greater than in 1919, and apart from 1917 and 1918 is the largest recorded since these returns were first collected in 1885.

Turnips and swedes were sown later than usual and remained backward for the greater part of the summer, but improved considerably during September and October. The estimated yield, 14.4 tons per acre, is $1\frac{1}{2}$ tons per acre above average, and is the highest since 1910. Crops were better than usual in practically all parts of the country except in the north-western counties and in Wales, where they were considerably under average. The total production is estimated at 14,200,000 tons, which is 3,000,000 tons greater than in 1919, and 1,500,000 tons above the average of the 10 years 1910-19.

Mangolds suffered considerably in the early stages of their growth from fly, and crops were often thin and patchy, but they grew well in the latter part of the season. Over the whole country the yield is estimated at 19 tons per acre, which is practically the same as the average of the previous 10 years, and is 3 tons per acre heavier than in 1919. Yields were well above average in most counties in the eastern half of the country, but were poor in the west. The total production is estimated at 7,292,000 tons, or 1,000,000 tons more than in 1919, but 630,000 tons less than the 10-year average.

The total quantity of roots grown this year is therefore considerably greater than last year, and with the large stocks of hay, farmers have generally an adequate supply of home-grown winter keep.

Corky Scab in Potatoes: Recent Investigation.—Corky Scab of potatoes is a disease of the tuber which in earlier stages resembles closely the ordinary scab so common in some soils. Under certain conditions it becomes serious and, unlike ordinary scab, penetrates the skin; a corky or spongy appearance results. Severely attacked tubers become shapeless and show shallow depressions which are filled with a sand-like material, the "sporeballs" of the fungus. "Second growth" seems particularly susceptible to this disease and not infrequently the combined action of second growth and Corky Scab causes a tuber to have the appearance of being attacked by Wart Disease. This resemblance gives rise to the idea that immune varieties sometimes become infected with Wart Disease.

Owing to the severe attacks of Corky Scab in certain districts, more particularly in Derbyshire and Lancashire, the Ministry started a series of small experiments with a view to testing the resistance of different varieties.

It was known that some of the varieties immune to Wart Disease were particularly susceptible to Corky Scab, and unfortunately many of the gardens which were infected already with Wart Disease and where only immune varieties could be grown, proved to be infected with Corky Scab as well. Hence in the first place only varieties immune to Wart Disease were tested, although in one case "Sharpe's Express" was also tried.

Trials were undertaken at two Centres, namely, two adjoining garden plots in Derbyshire, near Stockport, and another garden plot at Gisburn, near Clitheroe in the West Riding. It was known that the soil in the Derbyshire plots was infected with Corky Scab, but less information was available concerning the Gisburn soil, although it was ascertained that the disease had been present there in former years.

In Derbyshire, where the Trials were carried out by officers of the Derbyshire Agricultural Education Sub-Committee, the following varieties were planted and the percentage attacked by the disease is given: "Great Scot" (100 per cent.); "Golden Wonder" (98 per cent.); "Flourball" (98 per cent.); "Arran Comrade" (95 per cent.); "King George" (80 per cent.).

On another plot in the vicinity, only "Great Scot" and "Templar" were grown, with the result that 95 per cent. of "Great Scot" were attacked but the severity of the disease was less, and 60 per cent. of "Templar" were attacked.

At Gisburn no variety was severely attacked owing probably to the slight infection present in the soil. On the other hand the intensity and percentage of attack varied, as is shown by the following table:—

<i>Variety.</i>	<i>Percentage of diseased Tubers.</i>	<i>Intensity.</i>
Edzell Blue	30	Severe
Great Scot	10 to 12	General
Majestic	10	General
Bishop	10	Slight
Dargill Early	10	Slight
Sharpe's Express	9	Slight
Lochar	9	Slight
Golden Wonder	8	Slight
Arran Rose	8	General
Kerr's Pink	6	Very Slight
Tinwald Perfection	6	Slight
King George	6	Slight
Ally	5	General
Templar	4	Very Slight

Note.—The Edzell Blue were in a low-lying part of the garden.

While no variety of potato appears to possess immunity from Corky Scab, some varieties have more resistance than others.

In every instance the soil, where the potatoes were grown, was heavy and had a tendency to hold water. The experience of the Ministry with similar cases of this disease shows that it is always more severe where the soil is damp or water-logged. The natural, and probably the most efficient remedy in dealing with soils producing potatoes attacked by Corky Scab lies in proper and efficient drainage.

Foot-and-Mouth Disease.—Kent (Wingham District).—No further outbreaks have occurred in this district, and the restrictions, which are now only applicable to a small area immediately surrounding the infected place, will shortly be withdrawn.

Herefordshire.—One further outbreak has occurred in the district which was subjected to restrictions on account of the outbreak at Mordiford on the 12th December last, namely, Pixley, near Ledbury, confirmed on the 12th January, 1921. One further outbreak has also occurred in that part of Gloucestershire which was added to the Herefordshire Scheduled District, disease being confirmed at Churcham on the 22nd December last. The affected animal in this case was brought from premises at Woolridge on which disease had previously been confirmed on the 16th December.

Shrewsbury.—No further outbreaks have occurred in the Shrewsbury Scheduled District, and prohibition of movement is now maintained only in respect of a small area comprising certain parishes in the immediate locality of the outbreaks. In the remainder of the district the restrictions have been considerably modified.

Lincolnshire (Lindsey).—A fresh centre of disease was brought to notice by the confirmation on the 22nd December, of the existence of Foot-and-Mouth Disease on premises at Old Clew, in the Borough of Grimsby. The usual restrictions were immediately imposed over an area of 15 miles radius from Grimsby. Further outbreaks at Old Clew, in the immediate vicinity of the original disease centre, were confirmed on the 23rd and 24th December, 1920, and on the 2nd January, 1921. Outbreaks also occurred at Barnoldby-le-Beck, just outside the Borough of Grimsby, on the 31st December, and at Bradley, Grimsby, on 8th January.

On the 27th December a fresh centre of disease was confirmed at South Ormsby, near Alford Lindsey, outside the district already subjected to restrictions on account of the outbreaks at Grimsby. It was accordingly necessary to impose restrictions over a further district in Lincolnshire, adjoining that under restrictions in connection with the Grimsby outbreaks.

A further outbreak was confirmed in this neighbourhood on another farm in the occupation of the same owner on the 3rd January.

Worcestershire.—On the 25th December, Foot-and-Mouth Disease was confirmed on premises near Droitwich. No apparent connection could be traced with any other outbreaks, and the usual restrictions were accordingly imposed over an area with a radius of 15 miles from the infected premises. This area included the City of Birmingham within its boundary.

Birmingham Abattoirs.—On the 26th December, one of the Veterinary Inspectors of the Ministry reported that 36 animals affected with Foot-and-Mouth Disease had been found in Birmingham Abattoirs; these had been moved there from 3 markets, including Rugby (Warwick), Rugeley (Staffs.) and one other market (unknown). The slaughter of all animals in the abattoirs was immediately advised and was completed by the 29th December. The following day disease appeared amongst other animals in the abattoirs, which had arrived from no less than 7 markets. The lesions in the affected animals were in some cases at least 5 days old, and there were reasons to suppose that other animals which had been slaughtered and disposed of in the abattoirs had also been affected.

As the origin was probably an undiscovered centre in the Midlands, possibly connected with the Herefordshire Group, an Order was made on the 27th December, prohibiting the movement of animals into or out of an area embracing the County of Warwick and the greater part of Staffordshire, Leicestershire, Northamptonshire, Oxfordshire, Gloucestershire, Worcestershire and a small part of Derbyshire. The Order also prohibited movement of animals into the area except for slaughter, and within the area except by special licence of the Local Authority.

On Monday, 27th December, disease was confirmed on the premises of a butcher at Sheldon, Worcestershire, about 5 miles from Birmingham Meat Market, and it is thought that infection was undoubtedly conveyed thereto from the abattoirs.

On the 8th January two further outbreaks occurred on premises in the city and one on the 11th January, apparently due to the outbreak in the abattoirs.

Banbury District.—On the 5th January, disease was also found to exist on premises at Edgcote, near Banbury, Northants, in the district scheduled on account of the outbreaks at Birmingham. A further outbreak connected with this case was confirmed at Swalecliffe, Banbury, on the 8th January, and a third at Adlestrop, Chipping Norton, Glos., on the 8th January. It has been ascertained that the last-mentioned outbreak was the origin of the two cases near Banbury, and that the disease was of old standing.

Yorkshire (East Riding).—On 4th January disease was found to exist on premises at Halsham, near Ottringham, and the usual restrictions were imposed on that date over an area of 15 miles radius from that place.

In view of the grave danger of the spread of the disease owing to the fact that so many markets were under suspicion, special warnings were issued through the Press calling the attention of the public to the serious position which has arisen, and appealing for the co-operation of all concerned in bringing to the notice of the Authorities any case in which there is reason to suspect that Foot-and-Mouth Disease may exist.

Rabies -- Wiltshire, Dorset and Hampshire.—Six further cases of Rabies have occurred in this district, viz., two on the 31st December last, at Southampton and Winchester respectively, two on the 8th and two on the 11th January, in Southampton. One of the cases on the 11th January occurred in a pony. Three of the dogs were not known to have been bitten by any other dog, but in the other cases the dogs had been in contact with affected dogs.

Glamorgan.—No fresh case has occurred since that referred to in the last issue of the *Journal*.

Berkshire.—One outbreak has been confirmed, viz., on the 23rd December last in the Borough of Reading. The dog had been in the owner's possession for six years and there is no definite evidence as to the origin of disease.

London.—It is hoped that in the absence of any unforeseen occurrence, it may be possible to release the outer portions of the district now subject to restrictions as regards movement out, at an early date.

Tithe Rentcharge: New Basis for Redemption.—The Ministry gave notice on 1st January that, for the purpose of the redemption of tithe rentcharge for which application is made after the 1st January, 1921, until

further notice, the "gross annual value" for the purposes of the Tithe Act, 1918, will be at the rate of £118 for each £100 of tithe rentcharge (commuted value), and the compensation for redemption will be seventeen times the "gross annual value" after the deductions therefrom prescribed by the said Act have been made.

The above figures have been settled on the recommendation of a Departmental Committee consisting of Sir Charles Longmore, K.C.B. (Chairman), Sir Henry Rew, K.C.B., and Mr. W. R. Le Fanu.

English and Welsh Seed Potatoes: Importation into Scotland.—The Ministry issued a notice to the press on 31st December last to the effect that the Board of Agriculture for Scotland have issued an Order under which the importation into that country of any "seed" potatoes grown in England or Wales is prohibited except under licence granted by that Board. Applications for the necessary licences should be addressed to the Board of Agriculture for Scotland, 29, St. Andrew Square, Edinburgh.

The Eggs (Description on Sale) Order, 1920.—The Food Controller has issued an order (No. 2408), dated 30th December, 1920, to the effect that, on and after the 3rd January, 1921, until further notice, a person shall not sell or offer or expose for sale, whether by wholesale or retail, as fresh eggs or new laid eggs or under any description of which the words "fresh" or "new laid" form part, any eggs which have been imported into the United Kingdom, unless the word "imported" or the name of the country of origin also forms part of the description.

The Egg (Prices) Order, 1919,* as amended, and the Egg (Restriction) Order, 1918,† are revoked as from the 3rd January, 1921, but without prejudice to any proceedings in respect of any contravention thereof.

Agricultural Training for Ex-Officers. It has been officially announced that no applications by ex-officers, and men of similar educational qualifications, for grants for training in agriculture under the Ministry of Agriculture and Fisheries will be considered if received after 31st March next.

* See this *Journal*, December, 1920, p. 890.

† See this *Journal*, March, 1918, p. 1481.

NOTICES OF BOOKS.

The Chemistry of Crop Production.—(T. B. Wood, C.B.E., M.A., F.I.C., F.R.S. London: University Tutorial Press, 1920, 5s. 6d. net.) This volume sets out, in the form of a connected story, the principles of crop production.

The author assumes on the part of the reader an elementary knowledge of the principles of chemistry and a familiarity with the simple chemical and physical manipulations. The result is to present the information given in a very readable and attractive form, and the mind of the reader is not distracted by numerous digressions into matters which belong essentially to the domain of chemistry and physics.

The story is developed by easy stages. The factors of productivity are first explained, the scientific principles underlying crop production are then discussed, and the limitations of application of these principles in practice stated. The reader is then shown how to apply in a practical way the knowledge thus presented.

Although primarily intended for students, the book deserves to be read widely by progressive farmers, to whom it will prove a treasury of information on the right and effective use of manures. In this connection the chapter on the general principles of manuring is particularly commended.

The general excellence of the volume is slightly reduced by imperfect reproduction of some of the illustrations. It may be hoped that when a second edition is published certain of the illustrations will be more perfectly reproduced.

Preservation of Fruit and Vegetables.—(G. W. S. and M. D. Brewer. Cheltenham: Harley & Healing, 1s. 6d. net.) This little handbook of 59 pages has been written with a view to assisting the householder in the home preservation of fruit and vegetables, and in the making of useful syrups and drinks for the household. The material is treated in sections, dealing with the subjects of fruit bottling, canning and pulping, fruit and vegetable drying, fruit drinks, including home-made wines and liqueurs, jam-making, jellies and chutney.

The work claims to be based on practical experience. It has already passed through two editions and is now published in an entirely re-written form. An index appears at the end of the book.

Cottage Building in Cob, Pisé, Chalk and Clay. Second Edition, July, 1920.—(Clough Williams-Ellis. London: "Country Life" and George Newnes, Ltd., 7s. 6d. net.)

That a work of a technical nature such as this should produce a call for a second edition within a very few months of first publication, is sufficient proof of the interest which its subject matter has excited among that large class who want to build, but seek an escape from the delay and cost of doing so with the usual materials. Mr. Williams-Ellis is no doubt right in attributing the greater part of this welcome curiosity to the section of his book dealing with pisé building. To the present edition some extra matter is added descriptive of the small holders' cottage at Newlands Corner, built as a pisé demonstration by Mr. St. Loe Strachey. The short interval between the first and second editions has, however, deprived the author of the opportunity of utilising much new material which has since become available—for pisé

building on a modest scale is actually in progress in many directions. As Mr. Williams-Ellis somewhat plaintively remarks: "Soil quite incapable of making good pisé will none the less produce enthusiastic pisé-builders" whom he has found "valiantly struggling with stiff glutinous clay and almost pure sand." Under such circumstances there must be many failures, all of which cause "true friends of pisé to view their troubles with as much anger as sorrow" for the discredit on the new movement brought about by these incompetents. Apart from such misdirected effort, however, work has been done which it may be hoped will serve to increase the fund of experience in this hopeful method of building, and it is pardonable to mention here the Ministry's pisé buildings at Amesbury, recently under notice in this *Journal*.

The Amesbury cottages are intermediate in character between pisé de terre and pisé de craie, the soil used being a blend of the loamy material just beneath the topsoil and the disintegrated chalk underlying it. So good a surface has been attained latterly (with increasing experience in handling) that in the last cottage to be built it has been found possible to dispense with internal plastering; finishing the wall surfaces, after making good pronounced inequalities, with a brush coat of lime and sand only, or cement and sand where exceptional wear is expected. The result of this surface treatment will be carefully watched; at present it appears to be quite successful, and should it prove enduringly so, a further important economy due to this material will have been secured.

International Year-Book of Agricultural Legislation, 1919.—

The International Institute of Agriculture, Rome, has recently issued its ninth Year-Book of Agricultural Legislation. The volume contains an introduction in English, in which the general course of the legislation of the world in 1919, bearing upon agriculture, is outlined. The remainder of the volume, in French, gives in summarised form, and under their relative subject heads, the various agricultural enactments, decrees and statutory orders of the chief countries of the world.

The price of the publication is 11s. 11d. Remittances should be forwarded to the General Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1.

Leaflets issued by the Ministry.—Since the date of the list given on pages 984-5 of last month's issue of the *Journal*, the information contained in the following leaflets has been revised and brought up to date:—

- No. 112.—Weeds and their Suppression.
- " 170.—The Use of Lime in Agriculture.
- " 228.—Prevention of Cruelty to Animals.
- " 244.—The Destruction of Rats.
- " 251.—Common Weeds—I.
- " 255.—The Workmen's Compensation Act, 1906.
- " 351.—The Development of Rural Industries and of Rural Social Life.
- " 360.—Growing Two Corn Crops in Succession (formerly Special Leaflet No. 50).

The following leaflets have been issued in the Permanent Series:—

- No. 350.—Profitable Plums and Damsons.
- " 361.—Repair and Maintenance of Threshing Machines.

The following leaflets have been withdrawn from circulation:—
Food Production Series:—

- No. 35.—Varieties of Oats for Spring Sowing.
- " 49.—Need for Caution in the Feeding of Livestock.

Special Series:—

- No. 50.—Growing Two Corn Crops in Succession.

THE JOURNAL OF THE MINISTRY OF AGRICULTURE

Vol. XXVII. No. 12.

MARCH, 1921.

NOTES FOR THE MONTH.

LIEUT.-COL. The Right Hon. Sir Arthur Griffith-Boscawen, M.P., has been appointed Minister of Agriculture and Fisheries in succession to Lord Lee of Fareham, who has been appointed First Lord of the Admiralty.

* * *

FULL publicity has been given to the reasons why it is considered inadvisable to introduce store cattle into this country,

Store Cattle : but in view of the fact that the demand is still being urged in certain quarters, recapitulation of the case may be timely.
The Case Against Imports.

In the first place it may be mentioned that the leading Agricultural Associations of whatever kind are strictly opposed to the import of " stores," and their opposition is based on sound knowledge of the case.

It should have been proved to the satisfaction of all concerned that there is in the policy of the Ministry no criticism, expressed or implied, of Canada's store cattle. Canada is not mentioned in the Act of 1896 upon which the existing prohibition is based; the healthy record of the Canadian herds is well known. In England, Scotland and Wales nearly two and a-half million beasts are slaughtered every year, and experts have calculated that Canada's possible contribution could not add four per cent. to this total, while if Canadian " stores " were admitted it would be difficult if not impossible, in spite of the attendant dangers, to close our ports to " stores " from other countries.

It is of vital importance that the British farmer should rear his calves, and to-day, for the first time since the War ended,

the balance between killing and rearing is about even. Clearly, if "stores" were admitted, the farmer's incentive to rear would be checked. Calves would go to the butcher in ever increasing numbers and the result would be that, not only the Nation's home-grown meat, but the national milk supply would gravely be endangered.

Further, there is no reason to believe that imported stores would be cheap. Shipping companies are unable to quote freight rates and the old cattle-fittings on certain ships, removed during the War, have never been restored. The price of home killed beef would not necessarily be reduced to the consumer by the import of "stores," for it is ruled by the price of foreign beef, and no farmer can increase his "stores" beyond the capacity of his yards, his grass and his arable areas. It cannot be pointed out too clearly that the farmer employs "stores" in order to make the best use of his grass or roots; the increase in the amount of meat that would result from a greater abundance of "stores" would not be great, because the number a farmer can feed is limited by the grass or roots he has been able to grow.

It is clear from the evidence before the Ministry, which has submitted the whole question to searching scrutiny, that the importation of foreign "stores," quite apart from the grave risks that would be incurred, would do nothing to help and much to discourage ninety-five per cent. of the farmers in these Islands, while failing to reduce the ultimate price of beef to the public. At the present moment no effective arguments have been adduced to destroy or even to impair the value of these considerations.

* * * * *

OF late there have been certain criticisms of the policy adopted by the Ministry to stamp out Foot-and-Mouth Disease—

**Foot-and-Mouth
Disease: The
Ministry's Policy.**

a policy that has prevailed with gratifying success for more than twenty years. People have been asking why, in view of the cost of compensation, isolation and cure should not be attempted. Investigation of the facts and figures shows that compensation over twenty years has averaged £11,000 a year, and that if it be regarded as insurance on the country's live stock, which is valued at three hundred million pounds, the premium works out at 0.8d. per £100 per annum. There is no reason to doubt that, if it were possible to do so, every country in Europe would adopt the same policy as our own, but the extent of Continental outbreaks forbids. For

example, in four months of last year, there were more than one million cases of Foot-and-Mouth Disease in Spain, and the cost of the isolation and cure policy in connection with them may be estimated at well over five million pounds. The same huge figure is quoted by a Dutch authority as the cost of Foot-and-Mouth Disease to Holland in the two years 1919 and 1920, while in 1919 there were upwards of one hundred thousand cases in France, and, for the first six months of 1920, seventeen thousand cases in Germany.

Apart from the vast expenditure involved in a policy that is followed on the Continent only because territorial boundaries are purely artificial and incapable of arresting a disease which in all probability is air-borne, we have to consider the immense disadvantages suffered by the Continental farmer. He is liable at any moment to find not only his farm but his market closed, and transport of stock forbidden for a long period whether by road or rail. In this country, thanks to the drastic but effective measures in vogue, it has been possible to keep in check the most dangerous outbreaks and reduce restrictions to a minimum. On the rare occasions when the carelessness of some dealer or farmer has rendered the sanitary cordon temporarily ineffective, it has been possible to search out infected or contact beasts and destroy them before outbreaks can become widespread.

In the opinion of all practical men who have given this question careful consideration and have surveyed the working of the alternative system on the Continent, the policy of the Ministry has received ample justification from results, and, while it is admitted that Foot-and-Mouth Disease is curable, it must be acknowledged that any attempt to reverse the present practice would result in making the disease endemic in these Islands. This condition would have a very bad effect, not only upon our great export trade in pedigree stock, but upon the national supply of meat and milk and the normal conduct of the farmer's business.

* * * * *

It will be remembered that a Bee Disease Bill, drafted in consultation with those actively interested in the industry, was introduced into the House of Lords on the 20th December last. Since then it has been decided that no new schemes involving expenditure of public money can be proceeded with. The Ministry has been compelled to inform bee-keepers that

**The Bee
Disease Bill.**

the Bill will not be proceeded with at present. The Ministry has also had in contemplation the establishment of a Bee Advisory Committee, which was intended to represent every section of the industry. Its function would have been to advise the Ministry on all questions of apiculture, including the question of legislation in regard to Bee Diseases. It follows from the enforced postponement of legislation that this Committee cannot be established at present. In the circumstances, the Ministry has appealed to bee-keepers to take the necessary steps to organise themselves in order to arrive at an agreed opinion on measures that may be taken, without special legislation, for the protection and furtherance of the industry.

. It is common knowledge that this country is spending something like £7,000 a day on imported honey, which is used, *inter alia*, for medicine, confectionery, the manufacture of blacking, and, unfortunately, to mix with home-produced honey for retail by unscrupulous dealers as a pure English product.

The possibilities of this country in the matter of honey production remain to be tested, and it is hoped that, now we have precise knowledge as to the action and nature of Isle of Wight Disease, it will be possible for British bee-keepers to develop their industry to a point at which dependence upon foreign and inferior material, purchased at a price the country can ill afford to pay, will become unnecessary

* * * * *

THE Stationery Office has now issued the Tenth Report of the Development Commissioners, and those who are interested in

The Tenth Report of the Development Commissioners. Agricultural Research will find in its pages an arresting record of scientific development. After dealing with the origin and purposes of the Fund and the methods of allocation

and administration, the Report considers the whole policy of research in Agriculture, and sets out in detail the work done at nearly a score of Research Institutes, beginning with Rothamsted and ending with Oxford. No deep study of this section is required to show that in all directions research is moving towards its goal and that the practice of farming is being quickened and revived by the devoted work of men and women who give all their energies to the solution of the special problems entrusted to their care.

The third section of this Report is an epitome of scientific research in agriculture and is of the happiest augury to the industry. Further chapters deal with local and special investigations in England, Wales, Scotland and Ireland, with the training of agricultural investigators, with Farm Institutes, with schemes for livestock improvement, with rural industries, the reclamation and draining of land, forestry, co-operation in agriculture, and agricultural development in the past and in the future. The last three chapters are devoted to Fishery Research, Inshore Fisheries, and the construction and improvement of harbours—matters with which the Fisheries Division of the Ministry is actively concerned.

The Report is a compendium of most varied information and no man engaged in any branch of agriculture can fail to derive advantage from its close perusal. Many of the facts dismissed in a few words are of absolutely illuminating quality. What can be more significant to the future of agriculture than the statement contained in this one sentence dealing with the work of the Plant Breeding Institute at Cambridge—"Already two varieties (of wheat) raised by the Institute have carried crops of twelve quarters per acre and over without becoming lodged, and there are indications that still better standing types can be obtained." When we consider that the average of production of wheat in this country is not more than four quarters to the acre and that the whole economic problem of the farm and the still larger problem of national food supply are dependent in no small measure upon the wheat return, it will be seen that there may be an opening here for a revolution in farming that will enable the country to reduce its dependency upon foreign sources of supply and the farmer to carry a large and well-paid staff with profit to himself. What this means to the re-population of rural England and to a proper adjustment between urban and rural areas may be left with safety to the dullest imagination.

In the beginning of last month, Hemyock, in Devonshire, established a Calf Club, the first of its kind in this country.

England's The idea of the club comes from America,
First Calf Club. and its adoption in England is full of
promise to the dairy industry. Under a well-considered scheme, the Club is composed entirely of the sons and daughters of local farmers and the ages of the twenty-one members vary from 14 to 18 years. Each member receives

a calf, for which the parents give a promissory note, and will have charge of it for a year, when all the calves will be examined by experts and prizes will be awarded to those members who obtain for their animals the highest number of points. If the rearers then wish to retain the calves they may do so, on redemption of the promissory notes. If they do not wish to keep them, the calves will be put up for auction and members will receive the difference between their original and present value. The calves, which are Shorthorns, have been selected from cows with good milk records, from 600 to 1,000 gallons annually.

A great stimulus has been given to the movement by the publicity it has received. The youthful members and their calves were photographed in the market place and these photographs have been very widely circulated through the Press. At an inaugural lunch, over which the youthful Chairman of the Calf Club presided, Mr. C. Carew, Member of Parliament for the Tiverton Division, expressed his pride in being the first M.P. in the British Isles to have the opportunity of attending such a function. It was pointed out in subsequent speeches that the whole object of the Club was to improve milk production, both in quantity and quality, and that Hemyock had not only established its claim to a place on the map, but had inaugurated in England a movement that would in all probability be followed throughout Great Britain, with great advantage to the general public and the dairying industry. In connection with the work of the Club, Mr. J. Mackintosh, of the Research Institute in Dairying, University College, Reading, delivered a lecture to the members on the proper methods of calf-rearing, pointing out the importance of light, airy and well-ventilated pens, dry floors, preferably of hard earth, cleanliness of the food supplied, and regularity in feeding. It is understood that the United Dairies, Limited, are associated with, and taking an active interest in this movement. In the United States of America, the policy of interesting children in live stock has been pursued successfully for a considerable time, and there are throughout the States many Agricultural Clubs entirely under the control of school boys and school girls. The idea is one that deserves encouragement, and it is safe to say that in the work just undertaken in Devonshire we have the beginning of a movement likely to enjoy a widespread development.

HOME-GROWN WHEAT PRICES.

THE Prime Minister received a Deputation from the National Farmers' Union, on the 16th February, in regard to the price to be paid for home-grown wheat of the 1920 crop.

The Deputation consisted of Mr. R. R. Robbins, C.B.E., J.P. (President, National Farmers' Union); Mr. J. Donaldson (Vice-President, National Farmers' Union); Mr. E. W. K. Slade, C.C. (Chairman, Cereals, Livestock and Wool Committee); Mr. E. G. H. Maddy, J.P., C.C. (Vice-Chairman, Cereals, Livestock and Wool Committee); Mr. H. Overman, C.B.E. (Representing Norfolk); Mr. W. Hasler, J.P. (Representing Essex); and Mr. A. D. Allen, O.B.E. (General Secretary).

The Prime Minister was accompanied by the Rt. Hon. Sir Arthur Griffith-Boscawen, Lord Crawford, and Sir Wm. Mitchell Thomson.

The Prime Minister discussed the matter in detail with the Deputation and in the course of the proceedings made the following statement:—

“ I do not think there is very much between us except on a matter of adjustment of figures. I have consulted my colleagues since my attention was called to this controversy. I feel personally, apart from the fact of being involved in it as Prime Minister and Head of the Government, under an obligation here. I made personal appeals to the farmers of this country, and I have taken a personal interest in the matter. The farmers of the kingdom responded in a way which I think is very creditable to British agriculture. There were other ways in which they could have made more money with less trouble, where they might have dispensed with a good deal of the trouble they are having with labour, but they met the wishes of the Government patriotically, and I gave this pledge to them after consulting the Cabinet, in order to give them a sense of security. The pledge which I then gave, interpreted by Sir Arthur Griffith-Boscawen in his answer in the House of Commons, I stand by in the letter and in the spirit, and where there is legitimate doubt I am prepared—and I do so after consulting the Cabinet—to give the benefit of the doubt to the farmers, because it is of paramount importance that there should be no feeling in any section of the community that the British Government has broken faith with them. Therefore I say at once that we stand by these pledges. That means, as I

understand, that the price that will be paid to the farmer in respect of wheat which he markets will be a price which is determined by the cost of milling wheat imported during the two preceding months."

With regard to the extent to which farmers were deprived of a free market, the Prime Minister observed that: "Until the market is restored to normal conditions, as long as you have the present relations between the millers and the Government, although there is de-control and you have got a free market, you are entitled to say that you are affected to a certain extent by the conditions which I indicate. We therefore do not propose to take advantage of the fact that we have de-controlled wheat on the 25th January. We shall stand by the pledge on the other assumption, but the transactions must be governed, of course, by the conditions laid down by me here. . . . I shall ask you, upon that basis, to meet the Ministry of Agriculture, the Ministry of Food and the Treasury, to thrash out exactly what, in figures, the working out of these conditions will mean. Do not let us have any further misunderstandings. If you do not arrive at an agreement, come back again and we will discuss it. All I can say to you now is that I am deeply concerned that there should be no sense among the farmers of the country that we have broken faith with them. As far as I am personally concerned, I regard it as a matter of personal honour. I give you my personal word, as well as my word as Head of the Government. . . . I feel deeply concerned that the farmers should not feel that they have been misled in the least. Here is another thing I want to say. I am not going to interpret these words in a technical sense, to give a purely legal interpretation to them. I want to give the interpretation to them that an ordinary plain man would give to them. After all, farmers are not lawyers. I should like to put myself in the position of a farmer reading these words, and say to myself, 'What would I understand, if I were a farmer, as to what guarantee I was getting?' . . .

"A bargain is a bargain, which means you cannot say, when it happens to be against you, 'That is not what I understood,' and on that you cannot say, 'Well, I think that is what it means,' because it happens to be in your favour. I only want to have an interpretation of it that plain, honest, straightforward men of business, not straining words and not quibbling about the meaning of words, would place upon it. By that the Government stand, and I am specially concerned to stand by it myself, and I mean to do it."

In accordance with the arrangement made by the Prime Minister, a Conference, attended by representatives of the Ministry of Agriculture and Fisheries, the Ministry of Food, the Wheat Commission, the Treasury and the National Farmers' Union, was held on Thursday, the 17th February, 1921.

A report of the proceedings is given below.

Sir Arthur Boscawen : Now, gentlemen, those of you who were present at the deputation at Downing Street yesterday remember that the Prime Minister made it perfectly clear that he intended that the pledge given in the first instance by himself, and afterwards by me, should be carried out in the spirit and that wherever there was a doubt, that the benefit of the doubt should be given to the farmers, because he did not think that you were persons who were in the habit of construing technical questions and Parliamentary or legal documents, and he wished, therefore, not to stand on any technicalities, but to carry out the promise in the sense in which it was generally understood. Well, that being so, he invited this Ministry to consult with the Wheat Commission and the Ministry of Food as to the best method of carrying out the undertakings he gave yesterday, and we have had two conferences, one yesterday evening and one this morning, and I will just indicate to you the conclusions we have arrived at, and will then ask for your views on them.

We take this position, that the promise was for a maximum price of 95s. provided that the c.i.f. cost of imported wheat was 95s. or above and so long as wheat was controlled. We hold that, technically, decontrol took place on the 25th January, but we are prepared to give you the benefit of the doubt, that is to say, inasmuch as there is still control of flour mills, we hold that, although technically there is decontrol, from the point of view of construing the pledge, there is no decontrol at the present, and we propose, therefore, that the farmer shall be entitled to get, so long as there is not decontrol, what was stated by me in the House of Commons, the average c.i.f. cost of wheat imported during the two previous months. Well now, the effect of that decision will be this—that as regards sales, so long as control still exists, the price will be announced based upon the two previous months' cost, and the millers will be instructed to pay the farmers for wheat of sound milling quality that figure, and for inferior wheat they will pay pro rata. Of course, we are only dealing with milling wheat, not chicken food or anything of

that sort. As regards sales that took place before, for instance, from the 6th November roughly up to the present time, where a less sum has been paid than 95s. (the maximum certainly operated at that time, because the price of imported wheat was above it) in those cases, where the seller has been paid, the millers will be instructed to recoup to the person from whom they bought wheat, the difference between the price actually paid and 95s. for wheat of sound milling quality, and in the case of inferior wheat that is still good enough for the mill, a pro rata difference.

Of course a difficulty arises there, which we quite realise, that a lot of the wheat was not sold direct to the miller, but was sold by the dealer, and there may have been several transactions. In these cases, all the miller can do will be to recoup the person from whom he bought wheat the difference, and it will be up to the National Farmers' Union to see that the proper sum is passed back to the actual producer. I understand that probably the National Farmers' Union would be able, in most cases, to arrange that. (The conference agreed that there would not be likely to be any difficulty on this point, although certain cases might possibly give trouble.)

Well now, there is one point I should like to mention. I have told you that the pledge was for a maximum of 95s. so long as control continued, and that we are prepared, for the purpose of carrying out the pledge, to accept your view that there is still control. If the pledge is to be interpreted literally, supposing decontrol did take place in the immediate future, which is not very likely, but still it might occur, say, on the 31st March, strictly speaking our pledge would be fulfilled because the conditions under which the guarantee was given would no longer exist, but it is certainly the intention of the Prime Minister, and, I think, of the Cabinet, that as the pledge was really understood to be a guarantee for the year, and as the date of decontrol is doubtful, that we should not boggle over it. We want the farmers to feel absolute confidence, and therefore we will to all intents and purposes see that this guarantee is given for the whole of the rest of the cereal year. (Hear, hear.) I suppose, strictly speaking, we should fix a date—say about the 13th August, but this is only a suggestion, it has not yet been fixed definitely.

Well now, gentlemen, that is in broad outline, the conclusion we have arrived at in order to carry out the statement and promise given by the Prime Minister yesterday, and I hope that the Farmers' Union will realise that the Prime Minister has

really met the position very fully indeed, and that he is prepared to go a long way beyond the literal interpretation of his original pledge. He has given you the benefit of the doubt in all cases, and I do hope that this will restore confidence. As you know we are very anxious to maintain as large an area under arable cultivation (wheat) as we can, and I hope you will do all you can to support us in our general policy.

Mr. Langford : I understood you to say that the miller would be instructed to make up the price to 95s. for good sound milling wheat, and pro rata for inferior wheat. Is it to be presumed that the miller only bought wheat of sound milling quality?

Sir Arthur Boscawen : Oh, no. It must be wheat of milling quality, but there are, of course, various grades.

Mr. Langford : I think it would be a very dangerous loophole. May I ask who is to decide whether the wheat was of sound milling quality or not?

Sir Arthur Boscawen : The miller.

The question was raised by a member of the conference as to whether a farmer delivering direct to the mill would be entitled to a 1s. extra, i.e., 96s., and this point was confirmed by Sir Arthur Boscawen.

Mr. Robbins, in reply to Sir Arthur Boscawen, said: We quite realise, Sir Arthur, that you have met us in a very generous and liberal spirit, and we do not want to appear grasping or dissatisfied, but one point occurs to me, and that is whether it would be possible to take any steps to increase the demand for home-grown wheat. So many of our people cannot find a sale. I wonder if you could do anything at all to relieve the situation?

After a short discussion on this point, it was pointed out to Mr. Robbins that the chief difficulty was the general fall in prices, but that everything possible would be done to assist the farmers in this connection, although it was difficult to see how anything very material could be done. Every inducement had been offered to the miller to purchase English wheat, but the supply was at the moment greatly in excess of the demand.

In reply to a question from a member of the National Farmers' Union, Sir Arthur Boscawen stated that the maximum price for February and March was known to be 95s.,

after which it was possible that it might fall, but due notice would be given of any alteration. He also stated that in the event of a large quantity of English wheat being offered to the millers, it was possible that they would only be able to absorb that of the best quality, and would be obliged to refuse the inferior grades, which in normal times would be used for milling purposes—this was an aspect of the question which would have to be faced. For this reason, although it was going far beyond the pledge given, it had been decided to extend the cereal year until the 13th August, and it was hoped that this extension over a longer period would relieve the pressure on the mills.

After some further discussion, it was decided that a memorandum should be drawn up, setting out the conclusions reached, which should be submitted to the National Farmers' Union in its draft state for observations.

The conference expressed its satisfaction at the decisions reached, and thanked Sir Arthur Boscawen for the manner in which the question had been handled.

The memorandum referred to above was considered at a Conference reported below between the Ministry of Food, the Wheat Commission, and representatives of farmers.

NOTE OF CONFERENCE HELD AT THE MINISTRY OF FOOD ON WEDNESDAY, 23RD FEBRUARY, 1921.

Present:—

The Rt. Hon. The Earl of Crawford and Balcarres, <i>Chairman</i>	}	Royal Commission on Wheat Supplies.
Sir George Saltmarsh, <i>Vice-Chairman</i>		
Mr. H. F. Paul		
Mr. A. E. Humphries		
Mr. W. P. Burton		
Mr. J. S. Bowles, <i>Secretary</i>	}	
Major S. R. Reynolds, <i>Technical Adviser, Flour Mills Control Committee.</i>		
Mr. W. Nash, <i>Secretary, Flour Mills Control Committee.</i>		
Mr. E. E. Beare, <i>Acting Assistant Secretary, Ministry of Food.</i>		
Mr. R. R. Robbins, <i>President, National Farmers' Union.</i>		

Mr. W. Haslar, *President, National Association of Corn and Agricultural Merchants.*

Mr. S. Armstrong, *President, Incorporated National Association of British and Irish Millers Ltd.*

Mr. G. S. Hall, *Secretary, Incorporated National Association of British and Irish Millers Ltd.*

AFTER discussion and amendment of a draft prepared by the Department, the following scheme was agreed for carrying out the promise given by the Prime Minister on the 16th February, with regard to an announcement made by him on the 11th March, 1920:—

Price of Home-grown Wheat—1920 Crop.

In order to give effect to decisions which have arisen out of representations recently made to the Government by the National Farmers' Union, it has been decided that in respect of past purchases, *i.e.*, purchases between the 8th November, 1920, and the 5th March, 1921, both dates inclusive, farmers or merchants who sold home-grown wheat to millers financially controlled by the Flour Mills Control Committee shall be reimbursed:—

- (a) In respect of each purchase of home-grown wheat of sound milling quality, *i.e.*, of fair average quality for the season fit for milling into flour for home consumption, the difference between the price paid by millers per quarter of 504 lb. and 95s. free on rail, or 96s. delivered into the mill;
- (b) In respect of each purchase of home-grown wheat of inferior quality or condition, the difference between the price actually paid and the value of the wheat *as compared with the value of wheat of sound milling quality* (namely 95s. f.o.r. or 96s. delivered into the mill).

The following procedure for giving effect to the above decisions has been agreed upon:—

1. The seller (whether farmer or merchant) will make his claim upon a form obtainable from (a) his miller, (b) the National Association of Millers, (c) the National Farmers' Union, (d) the National Association of Corn and Agricultural Merchants, or (e) in Ireland, the Department of Agriculture and Technical Instruction for Ireland.

2. The claim form when filled in by the seller will be submitted to the miller to whom the wheat was sold.

3. The miller will verify the claims by reference to his books, and, if satisfied, will sign the certificate printed on the claim form and return it to the seller.

4. The seller will transmit the certified claim to the Secretary, Flour Mills Control Committee, 100, Cromwell Road, London, S.W.7, for approval.

5. The claim will be retained by the Department, who will forward direct to the claimant a Receivable Order Cheque, the cashing of which in itself provides the necessary receipt.

With regard to purchases of home-grown wheat on and after the 7th March, 1921, millers will be instructed to pay 95s. per 504 lb. if purchased on rail, or 96s. if delivered by road to the mill, for home-grown wheat of sound milling quality, and corresponding prices for wheat of inferior quality or condition. As this will entail the use of more capital than is required for the purchase of home-grown wheat at prices bearing strict relation to the current prices of imported wheat in accordance with F.M.C.C. Circular No. 298, millers making purchases of home-grown wheat will be furnished on application to the Director of Finance with a remittance on account of a sum per 504 lb. on the total quantity purchased during the preceding week.

This sum will be the difference between 95s. per 504 lb. f.o.r. and the current selling price of imported wheats of similar or comparable quality. For this purpose, the c.i.f. selling price of Argentine wheat per 480 lb. as announced by the Royal Commission on Wheat Supplies from time to time shall be adopted as the value per 504 lb. of home-grown wheat at station, with the addition of 1s. per quarter if delivered by road to mill.

The price of 95s. per 504 lb. will continue so long as the average (c.i.f.) cost of imported wheat remains above the parity of that figure. This average will be the average of the c.i.f. cost of all milling wheat imported during the two preceding months, and of the actual and anticipated arrivals in the United Kingdom during the current month subject to an adjustment in respect of the lower percentage of flour of equal water content obtainable from home-grown wheat as compared with imported wheat. In the event of this price falling below 95s. prices will be revised by the Royal Commission on Wheat Supplies in accordance with the cost of imported wheat and announced monthly.

THE NEW FARMING LANDOWNER.

THE EARL OF SELBORNE, K.G., G.C.M.G.

THE agricultural landowner who let his land to a tenant farmer but did not farm any of it himself, and the tenant farmer who rented land from a landowner and farmed it but farmed no land of which he was himself the owner, have played a very important part in the history of agriculture and in the economic life of the nation during the past 200 years; but it is my belief that both classes are slowly passing away.

The partnership has been an odd one and much to the advantage of the tenant farmer. In good times he has been able to secure a fair commercial return for the capital he has invested in the industry, and, since annual tenancies replaced leases, he has been able to quit the business quickly when times have been bad. The landowner, on the other hand, in good and bad times alike has received a wholly uncommercial interest for the capital he has invested in the industry. In bad times he has been liable to have the cultivation of the land thrown on his hands without the experience or the equipment with which to cultivate it successfully, and, latterly at any rate, in good times he has been very chary about raising the rent. This comparison is the more remarkable when it is remembered that at least two-thirds of the capital employed in agriculture have been supplied by the landowner.

The cultivated land of England is not, as Socialists are fond of saying, the free gift of God any more than the coat that the Socialist wears is the free gift of God. The cultivated land, like the coat, has been manufactured by the use of the brains and the physical strength given by God. Any amount of land can be had in the centre of Africa for nothing to-day, because it is in its natural state and unmanufactured, or (to use the term which is applied to the manufacture of cultivable land) unreclaimed. Exactly the same process has taken place in England during the centuries since the Romans came here. With the exception of tracks of down or heath land England was one mass of forest, thicket, swamp, or bog, and, when a landowner to-day acquires an agricultural property either by inheritance or purchase, what he acquires is not the land in its natural state but the product of reclamation and the *industrial equipment of the land*. This equipment is also an

essential part of the process of manufacturing cultivable land because, even if the trees had been felled, and the roots and the underwood and the briars and brambles rooted up, and the swamps drained, the land would be of no use to the farmer unless it had been supplied with farm buildings, houses, cottages, fences, roads, and a proper supply of water. All this equipment as well as the reclamation itself has been supplied by the capital of the landowner. The capital the tenant farmer has supplied is that necessary for the wage fund and for the purchase of live and dead stock.

If anyone doubts the accuracy of my statement about the manufacture of English land he should pay a visit to the famous Experimental Station at Rothamsted. There he will find that 60 years ago a corner of a wheat field was enclosed and left alone, and it has never been touched by the hand of man since. That plot of ground has reverted to the natural state of England, brambles, briars, underwood and young forest trees, and Dr. Russell, the Director of the Experimental Station, has informed me that to clear that piece of land and make it once again fit for cultivation would cost more than the capital value of the land itself.

It may well be asked why the landowners were prepared to invest their money so unremuneratively in agricultural land. The only possible answer is, that the habit must date from the days when the possession of land brought a social status nothing else could bring, and real political power. It could not have been the mere desire to live in the country, or the wish for sport, because men have always been able to enjoy the amenities of country life and sport by the process of hire. Purchase was not essential for the purpose. Nowadays the possession of land brings with it no political power, and social status can be acquired by other means, and the custom of land ownership, which was dying hardly, has been shattered by the crushing weight of war taxation. Landowners who were not farming their own land have found that by selling that land they can double their income, partly by the increased yield of their new investment, and partly because they become released from those charges and outgoings which make the net return from the rent of agricultural land so much less to the owner than the gross return. This is the simple explanation of the reason why there have been such great sales in the last few years. The new, and hitherto unknown, feeling of insecurity thereby produced to the tenant farmer has been the

justification for what is called "the compensation for disturbance" section of the Agriculture Act just passed. These provisions, however, will certainly not tend to arrest the process of selling land. For the reasons I have given very few agricultural landowners will henceforth be able to afford, or, if they can afford, will care any longer to own land which they do not farm themselves.

The future of English agriculture I believe rests with the men who, whether on a small, moderate, or large scale, farm the land which they themselves own, and I believe that in the long run that is a surer economic basis for agriculture than the unbusinesslike partnership which I have endeavoured to describe. The returns from good farming will enable the owner-occupier to do justice to his land both as owner and as occupier, and to receive a reasonable commercial return for his capital; but to do this the farming must be good farming. The whole standard of farming throughout England must be lifted on to a higher plane than that on which it stands to-day. Not only bad, but indifferent, farming must disappear. The owner-occupier must educate his son so that he will know how to manage and farm his land properly and get the most out of it. His life's work will bring him into closer contact than ever with the agricultural labourer, and he will more and more appreciate the fact that that labourer, always really a skilled man, must necessarily become more skilled owing to the increasing use of machinery, and he will understand that low wages are an economic blunder as well as a social misfortune. He must, however, as firmly as courteously exact a full, honest day's labour for those wages, or he will not be able to live or give employment to anyone. The existence of occupying ownerships of every size throughout the length and breadth of England alongside the corresponding tenancies, which will necessarily long persist, will provide the most capable of those labourers with exactly that ladder of possible advancement which they have so much needed.

But there will always be owner-occupiers who are not able to devote the whole of their own time to their land, and those men will require the assistance of managers or bailiffs. It was one of the tragedies of the bad times in the 'eighties and 'nineties of the last century that, when landowners had land thrown on their hands which they had themselves to farm, they did not know where to look for a competent manager or bailiff, and they did not know how to pay a competent man

when they had found him. It is absurd to expect a man who has never had a proper agricultural education successfully to farm 1,000 acres of land and be responsible for the return on £10,000 to £15,000 of capital, and still more absurd to expect a man who has had such an education, and is competent, to be satisfied only with a salary of £150 or £200 a year and a house. Our agricultural colleges have always been turning out competent men of this class, but they could not find employment in England and they had to go to the Dominions or elsewhere to find employment. Henceforth there will be an increasing demand for this class, and the demand will create the supply, and our universities and agricultural colleges are now better equipped than they ever were to create the supply. How should such a man when found be paid? He may quite properly be guaranteed a minimum salary of £150 or £200 a year and a house to commence with, or in the case of large farming operations a larger sum, but the real way to reward him and to get the best out of him is to give him a good percentage on the profits as proved by properly and independently audited annual accounts. The most satisfactory relationship can be established on this basis between the owner-occupier and his manager.

It will be seen from what I have written that I at any rate am full of hope for the future of agriculture for that class which I have called the owner-occupier, and which includes within itself the small free holder and intensive cultivator of 50 acres living in a cottage and the owner of 5,000 acres living in a country house.

But for a long time yet there will still be landowners who do not farm all their land and who still let land to tenant farmers. Their duty seems to me to be clear; as long as they retain their land they must make every effort to fulfil their part even in these times of crushing taxation, and keep the land so equipped industrially that they can reasonably insist on the tenant farmer doing his part. They must regard it as a national duty as well as a proper precaution for the interest of their family not to tolerate bad or indifferent farming. They will be entitled to use the Agriculture Act to assist them in carrying out this duty, and they will be entitled to claim a full economic rent for their land. To the good farmers they are bound to continue to show that cordial and intimate consideration which it is universally admitted the old type of landowner always showed to his tenants. And those who have struggled

so manfully to preserve their family home and who would regard it as so bitter an experience to be obliged to leave it, must continue to realise as their fathers did that the process of quitting home may be just as disagreeable to the old-established tenant farmer as to the owner. When the land has to be sold every effort should be made to sell it at its fair value, whether by private treaty or by auction, to the sitting tenant; but, if the land is sold by valuation and private treaty and not by auction, then the owner will be entitled to protect himself by inserting a clause in the conveyance reserving to himself for a term of years the option of repurchase at the price for which he has sold the farm in case the purchaser decides to part with the farm within that period.

THE IMPROVEMENT OF PEATY SOILS.

PART I.—THE TRUE PEATS.

E. J. RUSSELL, D.Sc., F.R.S.,

Director of the Rothamsted Experimental Station.

THERE are three types of peat soils in England, differing markedly from one another, and presenting entirely different possibilities of improvement. They are:—

- (1) Fen soils, found in the eastern counties: Cambridge, the Isle of Ely, Norfolk, Huntingdon, &c.
- (2) Low-lying peat soils, found in Lincolnshire and in the west, such as the Carr soils of Lincolnshire, Nottinghamshire, the peats of Chat Moss, near Manchester, and other Cheshire mosses.
- (3) High-lying peat, found in the west and north, e.g., Dartmoor, the Pennine chain and its outliers, Hambleton, &c.

The fen soils are distinguished by the fact that they are not strongly acid, often indeed not acid at all; they are very tractable and are practically all in cultivation. Drainage is the chief requisite; when this is done the land becomes very fertile. There is little now left for the improver to do, excepting after a disaster like the breaking of a bank by the Little Ouse in the Southery Fen, Feltwell, on 3rd January, 1918, when 20,000 acres were badly damaged. A few wastes still survive. One of these occurs in Wood Walton Fen, near Ramsay St. Mary's, Hunts. Part of the fen is deliberately kept as a sanctuary for wild life. The rest, however, is agricultural land, but as the lower part is liable to flood it has been left uncultivated and is now a dense thicket of birch and willow; some had been cleared by a previous tenant but was allowed to become derelict and covered with couch, and in places by rushes. The management of the land is now in the hands of Mr. A. Lancaster Smith, and his reclamation methods are described in *Country Life*.* Briefly the method is to raise the banks so as to keep out flood water, to break up the land with tractors, and then to grow potatoes, buckwheat, &c. Fen soils benefit by additions of clay but not of sand: they do not as a rule respond to lime—though this particular district is an exception—the most striking effects are produced by superphosphate, but not by basic slag. Some of

* *Country Life*, 7th September, 1917, p. 187, and 21st June, 1919, p. 766.

the fen soils—including this one—respond to potash and also to nitrate of soda and sulphate of ammonia; others do not, however, on the so-called clay fen in the western side of the region.

Any farmer in the fens having small derelict areas in his possession would be fully justified in reclamation. Some of the Cumberland peats seem to resemble the fen soils in that they do not markedly respond to lime; they benefit, however, by dressings of slag.

The low-lying Peats.—Like the fen soils, these require drainage before anything can be done, but in addition they require large dressings of lime as, unlike the fen soils, they are strongly acid. When the work is properly carried out reclamation is quite a feasible and often a profitable process. Two general methods are in use:—

(1) The land having been drained, ameliorating substances (such as lime, artificial manures, &c.) are added and the peat is cultivated as if it were normal soil.

(2) The peat is removed and sold, and if the climate allows, the underlying formation is drained if necessary and then either—

(a) Ploughed up;

(b) Covered with town refuse and then cultivated; or

(c) Warped, *i.e.*, systematically flooded with tidal water carrying silt till several feet of soil have been formed; this is possible only in a few areas, *e.g.*, Lincolnshire, lying below high-water level.

The first of these methods is adopted in Ireland and on the Continent; it is much investigated at the Experimental Stations at Jönköping (Sweden). Bremen (Prussia). Munich and at Arnhem (Holland). It has been tried at Wadfast Moor, Cornwall.

Some of the Irish attempts have been described in the Journal of the Irish Department of Agriculture for 1915 by Mr. Duncan. The problem is complicated by the existence of more than one kind of peat, *e.g.*, potash sometimes produces marked effects, and sometimes does not; before any important reclamation could be carried out it is necessary to make a careful study of the kinds of peat concerned. Two Scotch reclamations are described in the Highland Society's Transactions for 1899.*

The Jönköping experiments are carried out under the able direction of Professor von Feilitzen, and are described in the reports issued by the Swedish Society for Moor Culture.†

* Vol. 11, p. 150.

† Abstracts appear from time to time in the Jour. Board Agric.

The Belgian and Dutch methods consist in drainage, then addition of sand,* followed by deep ploughing and liming. The work is done by land reclamation companies† who acquire considerable experience and achieve much success. An interesting feature is the addition of farmyard manure. At first sight this addition of organic matter to a peat soil looks like "carrying coals to Newcastle," but it is founded on successful practice. In Holland it is not unusual to make up a heap of farmyard manure, soil, waste vegetable matter, &c., and leave it for some time to "ripen," and then spread it on the soil at the rate of about 2 tons per acre. The idea is to introduce the necessary soil bacteria into the peat which normally contains quite a different micro-organic flora. After this has been done a plant of clover is said to be obtained with more certainty than before. It is not clear that other crops benefit directly, but of course, any improvement in the clover reacts on the crops coming afterwards.

The second type of method—the removal of the peat and treatment of the underlying soil—has proved more popular in England because the high market-value of peat helps to set off some of the capital cost of the work. The removal and sale of peat is perfectly sound in principle. Peat is an asset of considerable value, but it is essentially a wasting asset: it disappears at a measurable rate after the drainage necessary now-a-days. Under modern conditions peat cannot be conserved for future generations, and we are therefore justified in using it ourselves even if the process be somewhat wasteful.

The best known example is the reclamation of Chat Moss, near Manchester, on which ashpit and other city refuse was carried after the peat was removed. The estate was taken over by the Corporation of Manchester in 1895, and after some adjustments consisted of 2,536½ acres, for which £130,969 was paid. £60,215 was spent on erecting and laying out farms, roads, light railways, &c. The rents during 1915 amounted to £5,313. The very similar Carrington Estate of 1,100 acres was purchased in 1886 for £39,166: nearly £44,000 was spent in drainage, light railways, roads, farm buildings, &c., making the total cost £83,142. The rents during 1915 amounted to £2,110. Thus the increase in agricultural value is not sufficient to carry the whole cost of the improvements: the City, however, gains in other directions in that the areas provide convenient

* Several attempts have been made to find out what the sand does.

† Such as the *Nederlandsche Maatschappij*, Arnhem.

dumping places for its refuse, whilst there is the possibility of further income from the sale of peat.

Another area worked on the same principle is near Edinburgh, where city refuse is carted out and then used for farm land. Again the increased agricultural value does not pay the whole of the cost of the reclamation, the city having to pay for the advantages of having a dump for refuse, and a place where relief works can be carried out.

Carr Soils.—These form an interesting example of peat soils that present some difficulty in management. The name is given to low marshy peat land containing the remains of old trees, birch, alder, &c. The word "Carr" is of Scandinavian origin denoting a marsh. In Nottinghamshire the "Carr" forms a strip of land about 2 miles wide and 15 miles long, lying south of the river Idle and north of the Trias escarpment on which stand Everton, Gringley, &c. The top 9 in. of peat appear to be formed from grass and rushes; the lower 9 in. to 15 in. from decayed wood. There can be little doubt that the upper layer was much thicker when the land was first drained during the Napoleonic Wars, and the original venturers were well repaid by the bounteous crops of rape and oats. The cropping seems to have been of an exhausting nature, and it was made worse by the paring and burning which accompanied it.* With the disappearance of this layer of grass and rush peat through shrinkage and oxidation the lower layer of wood peat has been brought into prominence, and is found not to be very satisfactory material. From the mechanical point of view the tree stumps and roots are a great nuisance, holding up the plough, sometimes even throwing it out of the ground. Regarded chemically, peat formed from wood is of little promise, comparing very unfavourably with that formed from grass or rushes. Without definite trial there could be no certainty that methods successful on a fen would answer on the "Carr." There appears to be evidence of definite plant poisons in the peat, oats and mustard having failed unaccountably.†

The analysis of the soil is as follows:—

						(Upper layer).
						(Mid. Agric. Coll.)
Organic matter (loss on ignition) ...	...	...	...	...	...	57.8
Nitrogen ...	...	...	...	...	...	2.11
Potash ...	...	...	...	...	...	0.60
Lime ...	...	...	...	...	...	1.06
Magnesia ...	...	...	...	...	...	0.28
Phosphoric acid ...	...	...	...	...	...	0.26

* R. W. Corringham, J. Roy. Ag. Soc. 1845, Vol. 6. p. 40

† E. E. Stokes, J. Bd. Agric. 1913, 20, 672

Thirty years ago there was still a certain amount of arable cultivation, but it has now declined and the land remains in poor grass, largely Yorkshire fog, which becomes badly infested with rushes. It affords a certain amount of grazing for bullocks and pit ponies.

The land could probably be converted into arable, but two steps would seem to be involved in its reclamation:—

(1) Improved arrangements for drawing off the water, the level of which in the soil is now somewhat too high owing to the shrinkage of the peat.

(2) More body seems to be needed in the soil, especially in the "wood" peat.

The soil is underlain by clay, and the most hopeful method of improvement for the arable land would appear to be the claying process carried out successfully on the "clay" fen in the Isle of Ely. This involves the digging of trenches down to the clay which can then be thrown out; but the peat is light and not deep. On the road across the "Carr," which is bordered by a deep drain, and therefore presumably received some of the clay thrown out during the excavation, there is a considerable development of clover and a vastly better herbage than is afforded by the mass of *Holcus* and rushes in the main part of the "Carr."

(3) Lime and fertilisers would certainly be needed.

The programme probably looks more formidable than it really is, and the position of the land promises a return.

It is possible of course that the area could be warped, as is done on the other side of the river in the Hatfield Chace and Thorne Moor district, and this would be a final and satisfactory solution. This, however, is an engineering problem which the writer is not competent to discuss.

As an alternative, the land could be used for permanent grass, liberally treated with phosphate, mown occasionally to keep down rushes, and periodically reseeded when *Holcus* has become too prominent. Probably the best system would be a combination of the two; using long leys with intervening arable periods.

High-lying Peats.—These present the most difficult case of all because the high rainfall intensifies their naturally wet character, and the coldness makes agriculture very difficult.

Many attempts have been made to reclaim the high lying peats, but few have met with success. Mr. Pell, in the *Journal of the Royal Agricultural Society* for 1887, records a case where

£24 7s. 6d. spent per acre in the reclamation led to an increased annual rental of only 8s. 2d.

The most interesting case is that of Dartmoor. Somewhere about 1780, Mr. Gullet began reclamation on the farm which is now known as Prince Hall, and Mr. Bray began at Bairdown Farm. Gullet was succeeded by Mr. Justice Buller, who, we are informed by Robert Fraser in his Survey of 1794, "finding that his health was greatly improved by the purity of the air," settled on the moor at Prince Hall and started farming; his successor, G. W. Fowler, continued the work from 1846 onwards. But the great 18th century improver of Dartmoor was Sir Thomas Tyrwhitt, of Princetown, an account of whom was published by Mr. J. Bocking-Rowe in the Devon Association Proceedings for 1905.* In 1854, Henry Tanner, estate agent of Exeter, published a prize essay on "The Cultivation of Dartmoor as a source of employment for the unemployed population of the district," and claimed that oats, vetches, clovers, grasses, rape, turnips and swedes could all be grown successfully. He was very hopeful about reclaiming the moor.

An account of the old Prison Farm is given by Mr. F. Punchard, in the Journal of the Royal Agricultural Society for 1890,† showing that land previously rush covered was then carrying a bullock per acre in summer, while distinctly good results were obtained on arable land. The present day condition of the farm hardly comes up to Mr. Punchard's account, no doubt because of the difference in the amount of labour available.

The land was first trenched, then drained, sown with rape which was fed off with sheep, followed by swedes fed off with sheep also receiving cake and corn, then followed 2 or 3 years of seeds, then barley with which was sown the following mixture of grasses, which were intended to remain permanently: perennial rye 8 lb., Italian rye 4 lb., cocksfoot 3 lb., meadow grass, timothy and meadow foxtail 2 lb. each, fescue 1 lb., cowgrass, trefoil and white clover 3 lb. each, alsike 1 lb.; in all, 34-36 lb. per acre.

During the War a considerable scheme was undertaken by the Duchy of Cornwall, under the supervision of Mr. H. Vendelmans, a Belgian expert.

The area under treatment lies to the east of Princetown. It stands at an altitude ranging from 900 ft. to 1,250 ft. above

* Other information is contained in the notes to "Dartmoor," a poem by N. T. Carrington (1826).

† Series 3. Vol. 1, p. 534.

sea level, and it has a rainfall of 85 to 95 inches. While somewhat warmer than the northern moors it is distinctly cold in spring and autumn. The peat is strongly acid and consists of two layers; the upper about 4 in. in thickness formed of partially decayed vegetation (the heather breaking down more easily and the sedges taking longer); the whole however is difficult to plough; the lower layer is composed of black decomposed material. Below this again comes a dark brown or chocolate coloured layer of earth several inches in thickness, probably at one time the original surface soil until it became covered up by a deposit of peat. It is gritty and stony, but usually it has not formed a continuous hard layer of rock or "pan." It must, however, be broken so as to allow full liberty to plant roots. Underneath lies a considerable depth of reddish brown or yellowish earth with occasional patches of white clay. This is so gritty and contains so many pebbles that it is not likely to prove hopelessly retentive of water; further, it is deep in many places. The lowest layer of all is the granite, from which the whole formation arises. Much of the granite is light coloured. It disintegrates very readily on exposure to weather as is well seen in the little quarry near Two Bridges at the junction of the Tavistock and Princetown Roads.

Assuming the land to remain in arable cultivation the 9 in. of peat now covering it would gradually oxidise and disappear, bringing more and more into prominence this old surface soil; its composition is as follows:—

	Black or chocolate coloured layer (probably original surface soil), 9 in. to 15 in. from present surface.			Reddish earth (original subsoil underlying black layer), 15 in. to 24 in. from present surface.		
	1	2	3 (8 in. to 11 in.)	1	2	3
Fine gravel ...	17.1	7.9	9.2	18.2	13.8	10.8
Coarse sand ...	16.5	19.5	32.1	17.1	16.4	27.0
Fine sand ...	23.3	24.1	20.9	19.5	18.5	20.9
Silt ...	14.7	18.4	11.8	17.0	19.4	17.1
Fine silt ...	9.7	11.5	10.5	11.6	10.6	7.7
Clay ...	2.4	2.8	2.6	4.4	7.4	4.6
Loss on ignition ...	12.4	12.7	10.3	7.8	9.8	8.4
Phosphoric acid (P ₂ O ₅) Total ...	0.03	0.05	0.03	0.04	0.06	0.02
Potash (K ₂ O) Total ...	0.23	0.23	0.28	0.41	0.41	0.44
Nitrogen ...	0.22	0.26	0.22	0.11	0.15	0.12
Carbonates ...	Nil	Nil	Trace	Nil	Nil	Trace

This new soil should not prove difficult to cultivate if it were not for the high rainfall, but its fine silt would tend to make it sticky. It is very deficient in plant nutrients, and like the present peat layer would need lime, phosphates, nitrogen and potash; drainage would also be essential.

In general the plan of reclamation proposed by Mr. Vendelmans follows the lines successfully adopted in the low lying peats of Belgium and Holland, viz., deep ploughing followed by the addition of sand. It is not necessary, however, to add sand on Dartmoor as the peat is only about 12 in. thick, and is underlain by a layer of sand which is brought up to the surface during the ploughing.

The first ploughing is very troublesome owing to the uneven nature of the surface. In some places the entire plough fell into a hole 3 ft. deep. Naturally it was impossible to do good work in these circumstances, and a good ploughman accustomed to turn a neat straight furrow would stand aghast at the roughness of some of the first attempts. After this ploughing, the land was left bare for a year; it was then harrowed, limed and ploughed over again. This time much better looking work can be done, and the land now begins to take on a normal appearance.

The land is cut up into fields of about 10 acres, between each pair of which a ditch is ploughed. Between successive pairs it was intended to make a plantation 25 yd. wide to protect the crops from damage by high winds.

The rotation proposed by Mr. Vendelmans had five courses :—

Buckwheat,
Winter oats,
Clover,
Oats for hay or silage.
Roots.

All these crops were successfully grown on the trial plots in 1916. The buckwheat was to be sown in May, and cut in August in time to drill the winter oats in September; clover was then to be sown in April. The oats for hay or silage were to be cut while still green, and harvested by the ordinary Belgian method, or made into stack silage as is done by Baron Peers of Bruges.

The field trials of 1916 brought out several important points. The great need of lime was demonstrated; the crops having failed completely on most of the plots from which it was withheld. Even 1 ton of lime per acre was insufficient for oats, though it proved enough for turnips and potatoes. Cabbage and kohlrabi failed except where potash was supplied; clover also

showed marked need for this fertiliser. Phosphates had striking effects on turnips where lime was present, but not otherwise; they also acted well on oats. With these results established it is not difficult to draw up a scheme of manuring suited to the rotation.

The subsequent years, however, have shown that the original scheme needs modification. A recent examination by the writer showed that much of the vegetable matter was still undecomposed, especially the roots and stalks of the common sedge, locally called Carnation grass (probably *Carex panicea**). But the worst feature is the high rainfall, which is between 80 and 90 inches per annum, and is apt to be accompanied by high winds. One day during my visit I found it impossible to walk over the arable land, although accustomed to rough weather and well protected against the rain. For days afterwards no horses could get on to the land. Oats therefore had not been a success; it had been a sheer impossibility to sow them in time; nor indeed could they have stood up against the wind and rain even if they had been sown fairly early.

The root crops on the other hand—swedes, turnips, rape—were looking well *where lime had been liberally used and could still be found on the surface*. Some of the roots were very fine and the crop was probably about 20 tons per acre; but they were a complete failure on two sections where the lime had been ploughed in, and so carried below the surface.

Cabbage might have succeeded, but they were liable to be blown out of the ground. Finger and toe is unknown in any of the crops.

Grass also does well, and the sown grasses are so marked an improvement on the wild vegetation that the cost of the breaking up will no doubt be repaid by the increased value of the herbage, even without taking any account of the arable crops obtained. Cocksfoot is growing very vigorously, rye grass also persists, and there is a fair take of timothy.

The reclamation must be regarded as an experiment, the results of which will not be certain for some years to come. There is no similar case elsewhere so far as I know. The lines appear to be sound. If the reclamation succeeds it will open up considerable possibilities of future developments; and if it fails after an honest attempt to carry it through, it will have demonstrated the fundamental difficulty of cropping at high altitudes.

* In absence of flowers and seeds identification was impossible.

It is, however, by no means certain that the improvement in the grassland can be effected only by breaking up and resowing after two or three years interval. On some of the old fields basic slag has been used, and the contrast between the slugged and the unslugged part is very marked; the original herbage is poor, but after addition of slag the white clover becomes very prominent without breaking up or reseedling. There is a heavy demand for slag throughout Great Britain for normal farming, but mineral phosphates can be had in quantity and they would be well worth trying. It might be desirable to break up strips of land in among the unbroken grass and then sow with a suitable mixture; these would furnish starting points for colonisation of the wild areas with better grasses and clovers.

At present the Dartmoor farmers take in sheep and cattle for summer grazing on the "Newtakes" and they winter a few beasts of their own; the winter beasts pay the rent and the summer beasts furnish money for living—the grocer's bill, however, being met by eggs, poultry, milk, &c., often by a process almost amounting to barter. The sum payable for summer grazing for the cattle used to be 5s. each, now it is 7s. 6d. or sometimes even 10s. for the season, June to September; for sheep the payment is 30s. per score. The owner bears the loss of the sheep (if any) the farmer being paid for all sent, not simply for those returning (as in the Weald). On one farm of 1,200 acres the farmer was expecting to receive £127 for summer grazing, though in a previous year the tenant had taken 250 cattle and 3,000 sheep, which then brought in £270; this, however, proved too great a strain on the land to allow of repetition.

It seems clear that the introduction of more arable land would increase the amount of roots and hay, and therefore allow of the wintering of more stock; further, that the improvement of the fenced in grassland by means of phosphates would allow of more summer grazing. Thus considerable improvement could be effected without altering the system of husbandry which has the merit that it accords with the psychology of the moorland people, and with their holdings and financial resources. Any increase in the head of stock wintered would necessitate the growing of more oats, and it would be well to try experiments with some of the newer sorts, such as "Yielder," &c., well manured with phosphates to see if they would give better results than the present variety.

THE STARLING: IS IT INJURIOUS TO AGRICULTURE?

WALTER E. COLLINGE, D.Sc., F.L.S.,
The University of St. Andrews.

FOR many years past there has been taking place a sure but gradual change of opinion with reference to the economic status of the starling, for from one of our most useful wild birds it has become one of the most injurious. Its alarming increase throughout the country threatens our cereal and fruit crops, and the magnitude of the plague is now fully realised.

Writing in April, 1919,* we stated: "At the present time the starling offers a most serious menace to the production of home-grown food, and any further increase in its numbers can only be fraught with the most serious consequences." In the intervening two years the starling has undoubtedly increased to such an extent, and as a result of the great damage done to crops, farmers and fruit growers in all parts of the country realise the seriousness of this bird plague. The causes which have brought about the change in the food habits of one of our commonest wild birds are not at first sight apparent, but a closer study of its habits readily explains the deflection.

The starling is distributed generally throughout the British Isles, and, with the exception of one or two counties in Ireland, is abundant now in all districts. Its remarkable increase during the latter part of the nineteenth century attracted considerable attention, and many theories were advanced as to the cause. Some attributed it to the destruction of birds of prey, others to greater facilities for nesting places, while a growing abundance of food was cited by others. In the writer's opinion, however, it is due, *firstly*, to the security of its nesting site; *secondly*, to the change in its food habits; and *thirdly*, to the autumnal immigration. The increase has steadily continued, and at the present time it is almost as numerous as the house-sparrow. The usual nesting place was in the holes in trees, quarries, cliffs, &c., and these are probably its natural habitation. More recently, however, it has availed itself of the greater security afforded by houses, farm buildings, churches, ruins, &c., and occasionally it builds in the foundations of larger birds' nests. The actual nest is a loose untidy structure, consisting of straw or dried grass, leaves, wool or moss, lined with feathers. Both sexes assist in nest building. Five to

* National Review, 1919, pp. 252-257.

seven pale bluish eggs are laid early in April, and sometimes there is a second brood. Incubation is shared by both sexes, and extends over period of from 12 to 14 days; the fledglings are ready to leave the nest about three weeks later.

As has frequently been pointed out, this bird is most variable in its movements, even from the time of leaving the nest. Its habit of moving about in flocks during the spring and summer months constitutes a grave danger; while later the habit of collecting at special roosts frequently causes much damage to young fir plantations, shrubberies and reed-beds.

It is exceedingly difficult even approximately to estimate the actual number of pairs of breeding birds in this country, but for the purpose of illustrating the rate of increase we will presume that in 1917 there were 100,000 pairs of starlings breeding in Great Britain (which is considerably under the actual figure), and that each pair reared three pairs of young, half of each sex, and that all lived together with their offspring. The progeny and parents in a single year would total 800,000. At the end of 1918 this number would have increased to 3,200,000, the addition in 1919 would make the total 12,800,000, while at the end of 1920 there would be over 51,000,000 birds.

These figures are calculated on the basis of a single brood per year, though in many parts of the country there are two broods. Even allowing for a very high rate of mortality, it is clear that the annual increase is enormous, and supplemented as it is by immigrants, the number of these birds at present is far greater than the country can naturally support.

As the number of starlings has increased annually, a gradual change in the nature of the food consumed by these birds has taken place. There is fairly reasonable evidence to show that in the past the bulk of the food consisted of insects and insect larvæ, slugs, snails, earthworms, millipedes, weed seeds, and wild fruits; in more recent years this has been supplemented by cereals and cultivated fruits and roots. Some writers have affirmed that once the fruit-eating habit is acquired, they refuse the other available food.

As a winter visitor large numbers come to the British Isles from Northern and Central Europe, and others pay a passing visit when *en route* between Continental summer and winter quarters. From observation on the east coast of Scotland the writer can attest to the arrival daily during September, 1915, of flocks of starlings from one to five thousand. In 1916 the

numbers were much smaller, but increased again in 1917. During 1918 they outnumbered anything seen previously. Small flocks were observed on 7th September, and larger ones on the 8th. On the latter date one flock alone must have contained something between 150,000 and 200,000 birds, and on the 9th September a still larger flock was observed. This immigration of course occurs all along the eastern coast of England and Scotland, so that the actual number of arrivals must total many millions. The Continental visitors are darker in colour than our residents, and many of them remain here.

The depredations of this bird are known only too well, and require little further description. During the past two years the writer has visited many farms investigating the damage caused to newly-sown cereals. In some cases as much as 30 per cent of the seed was eaten. The loss due to re-sowing, where possible, is very great if the high cost of labour is taken into consideration, but where this is not possible it is a direct and enormous loss to the cultivator and to the nation. Again, in fruit growing districts the depredations of this bird become more marked annually, cherries, strawberries, currants, plums of all kinds, and more recently, apples and pears suffer. One grower states: "Only one bird is dangerous to my crops—that is, the starling. He threatens the utter destruction of our strawberry, raspberry, cherry, gooseberry, currant, and some other crops. These birds are said to come here from the marshes as soon as the young are hatched, and they come in millions—in flocks that darken the sky." Another grower writes: "During recent years this bird has increased to such an alarming extent as to be a plague. They come in flocks of tens of thousands, and whilst here commit an enormous amount of damage which must far outweigh any benefits they confer. Each year they seem to grow more plentiful. I am in favour of a very drastic reduction for some time to come."

In order to appreciate clearly the true economic position of the starling, it is necessary that the stomach contents of a large series of individuals should be examined, from various districts, and during each month of the year. Such an examination has been made, and as a result we find that of the total bulk of food consumed in a year 51 per cent. consists of animal matter and 49 per cent. of vegetable matter (see Fig. 1). Examined in further detail we find that the animal matter contains 26.5 per cent. of injurious insects and their larvæ, 3.5 per cent. of neutral insects, 2.5 per cent. of beneficial

ANIMAL MATTER.	51%
VEGETABLE MATTER.	49%

FIG. 1.

INJURIES.	41%
BENEFITS.	36.5%
NEUTRAL.	22.5%

FIG. 4.

INJURIOUS INSECTS.	26.5	BENEFICIAL.	34.5
SLUGS & SNAILS	6.5		
MILLIPEDES.	1.5		
BENEFICIAL INSECTS.	2.5	INJURIOUS.	2.5
NEUTRAL INSECTS.	3.5		
EARTHWORMS.	8.5	NEUTRAL.	14.0
MOLLUSK ANIMAL MATTER.	2.0		

FIG. 2.

CEREALS.	20.5	INJURIOUS.	38.5
CULTIVATED ROOTS.	2.5		
CULTIVATED FRUITS.	15.5	NEUTRAL	0.5
WILD FRUITS & SEEDS.	7.0		
MOLL. VEG. MATTER.	3.5		

FIG. 3.

insects, 8.5 per cent. of earthworms, 6.5 per cent. of slugs and snails, 1.5 per cent. of millipedes, and 2 per cent. of miscellaneous animal matter. The percentages of the different items are expressed diagrammatically in Fig. 2. Further inquiry into the nature of the vegetable matter shows it to consist of 20.5 per cent. of cereals, 2.5 per cent. of cultivated roots and leaves, 15.5 per cent. of cultivated fruits, 7 per cent. of wild fruits and seeds of weeds, and 3.5 per cent. of miscellaneous vegetable matter of a neutral nature (see Fig. 3).

If the monthly averages are examined we find that the percentage of animal matter is greatest in April, May and June, the respective percentages being 65, 92 and 87. The highest percentage of fruit is found in July, August and September, and the highest percentage of cereals in September, October and March. In some districts the total percentage of injuries during the months July to October is nearly 100, in other words, cereals and cultivated fruits form the main items of food during this period of the year.

Summarising the above figures, we find that 36.5 per cent. of the starlings' food constitutes a benefit to the agriculturist, 41 per cent. an injury, and 22.5 per cent. is of a neutral nature. These percentages are expressed diagrammatically in Fig. 4. The difficulty is how to balance these figures. This can be accomplished only by interpreting the economic value of the different items in the light of experience gained in such work.

Let us first examine the nature of the benefits. Amongst the insect food we find large numbers of click-beetles and weevils, a few June bugs, wireworms and many beetle larvæ. (The starling does not consume anything like the number of wireworms that the rook does.) Surface larvæ such as those of the Garden Swift Moth, the Heart and Dart Moth, the Great Yellow Underwing Moth, and the caterpillars of the Winter Moth form a considerable item, also leather-jackets and the larvæ of other Dipterous flies. Slugs and snails constitute the next most important item. Millipedes are occasionally taken, but are not a large item.

All the above-mentioned insects are exceedingly injurious to agricultural and fruit crops, and the number of individual forms destroyed must be very great. It is necessary to bear in mind, however, that the bulk of this kind of food is consumed in April, May and June, that is to say, for a period of about three months the starling is wholly beneficial, for another three months it is partly so, and for the remaining six months it is harmful.

A point in the starling's favour, is the nature of the food brought to the nest by the parent birds during the nesting season, which covers a period of about three weeks. A volumetric analysis of the stomach contents of 40 nestlings shows that injurious insects constitute 89 per cent. of the total bulk of food, neutral insects 1.5 per cent., earth-worms and slugs 6.5 per cent., and miscellaneous matter 3 per cent. Amongst the insects we find the larvæ of the Great Yellow Underwing Moth, various Noctuid and Geometrid larvæ, wireworms, leather-jackets, and many Dipterous larvæ, weevils and numerous small beetles. In addition to feeding the growing and rapacious nestlings upon this diet, there is every reason to suppose that during this period the parent birds also partake of a similar one. It is, however, important to bear in mind that this period is confined to three weeks only, or six where there are two broods, and as we have previously shown, while the animal diet of the adults during April, May and June is remarkably high, it is almost negligible during July, August, September, October and March.

Almost every farmer is aware of the damage done by these birds to autumn and spring sown cereals: large areas of newly sown land are laid waste. In many cases great loss is occasioned by the rooting up of seeds which are not consumed. In a like manner the fruit grower can recount serious damage to strawberry, raspberry, gooseberry, currant, cherry, plum, pear, and apple crops, and here again a large tonnage of fruit is damaged apart from that actually eaten.

The above figures were obtained from investigations on the starling up to the end of 1918, but we are convinced that a new inquiry at the present time would show that the injuries had become greater, and the benefits less, owing to the further increase in the number of individuals. Moreover, if we examine the food of starlings from limited areas we find that in spite of the large number of injurious insects they eat in agricultural districts, the percentage of cereals and cultivated roots is so high that the species must be condemned. In a like manner, in fruit growing districts the injuries far outweigh the benefits conferred. Examined from almost any standpoint the unprejudiced mind can come to one conclusion only, viz., that the starling has long since risen above the "high water mark of abundance" and in consequence is doing more harm than good. In other words we have too many specimens of one species requiring the same kind of food within a limited area, and as the late Professor Beal pointed out, this is the cause in nearly all cases where a bird becomes injurious.

If further evidence were needed against the starling it is supplied by its activities in other countries. When first introduced into Australia it was generally regarded as one of the most beneficial birds to the agriculturist and fruit grower, but with its rapid increase a marked change took place in its food habits to such an extent that in 1905 Mr. C. French, the Victorian Government entomologist, wrote: "There can be no doubt about the starling being a most pernicious enemy to the fruit grower and viticulturist in this State. The starlings are increasing a thousand times faster than their natural food, hence they must avail themselves of such as is obtainable. Once driven to this, an appetite is acquired, and fruit diet being easily obtained, they will not seek any other, even if available. It is pleasing to note that the Shire Councils are offering a bonus for starlings' heads and eggs Valuable insect-eating birds such as Kingfishers, diamond-birds, tree creepers, and tree swallows are being driven out of their nesting places in tree-hollows by swarms of starlings, and before long these insectivorous birds, useful to the farmer and orchardist, will be driven out of the State."

As yet the charge of usurping the nesting places and the destruction of insectivorous birds in this country is not proved, but it is only natural that this should take place as the starling family becomes the preponderating bird-factor in a district. The question naturally arises: "How are we going to attack this problem?" It is by no means an easy one, for any reckless or indiscriminate method of general destruction will only do harm. The object to be sought is not how to exterminate the starling, but how to reduce its numbers and to keep it within reasonable limits so far as the immediate future is concerned. To bring about the desirable end we would suggest the following course of action:—

(1) In all fruit growing and agricultural districts, the systematic collection of the eggs and the destruction of autumn immigrants.

(2) So far as possible, the making of all dwelling houses, farm and out-buildings starling proof, *i.e.*, blocking up all openings or facilities wherein the bird may nest.

(3) More stringent regulations for the protection of birds of prey, such as the Kestrel, Merlin, Hobby, the Tawny or Brown Owl, and the Little Owl.

(4) International co-operation with those countries from which we receive autumn immigrants.

(5) A new inquiry as the starling becomes reduced in

numbers, in order to gauge accurately its food habits under new conditions.

Failing some such action as indicated above, the agriculturist and fruit grower will be left faced with a growing enemy which is devastating their crops, and inimical to their interests, and the country with a portentous factor which is adding to the scarcity of home-grown food. In short, the starling has become a plague in the land and a source of great national loss.

REVERSION OF BLACKCURRANTS:

A METHOD OF IDENTIFICATION.

A. H. LEES, M.A.,

Plant Pathologist, Research Station, Long Ashton, Bristol.

MR. W. P. SEABROOK recently stated that his experience in inspecting growers' plantations is that not one grower in a hundred really knows when a bush is reverted and when not. With this dictum the present writer heartily agrees. It is, of course, no discredit to the fruit grower that such is the case. There is undoubtedly great difficulty in identifying slight cases, as the disease is very insidious in nature. In most diseases, there is a distinct and well-marked change in the appearance of the plant which soon makes itself evident even to the inexperienced eye. The case of reversion is otherwise. In its initial stages there is no very obvious change in the colour or shape of the leaf. It is only after the disease has advanced somewhat that a change becomes noticeable to the unskilled eye. Even then the colour change is but slight: the chief difference is in the shape.

These facts make identification of the disease, from the grower's point of view, a very difficult one, and it is not surprising, therefore, that most growers do not recognise it until it has reached a comparatively advanced stage. Nevertheless, it is obvious that it is extremely important that some method be found to enable the inexperienced to decide quickly whether or not any given bush in his plantation showed signs of disease. The great loss of crops entailed by it are well known, and in the present state of knowledge the only methods open to the grower of curtailing its ravages are propagation from sound stock and roguing. In order to keep the disease in check, the latter process must be done both in the cutting beds and in the plantation.

The method about to be described was tested during the 1920 season and found to be uniformly reliable. It enables the observer to detect the disease in its earliest stages, and can be used as a means of identification from about the middle of May until the end of the season, when leaf fall begins. On p. 1125 are shown seven leaves of the blackcurrant. Fig. 1 is a normal leaf, while Fig. 2-7 represent various stages induced by increasing amounts of reversion. There are two main points to observe in Fig. 1:—

(1) Leaf Venation.—The blackcurrant leaf venation is palmate in type. That is to say, the chief veins spread out like the palm of the hand, and, in this case, include five members. They all originate at the same point, which is situated at the extreme base, and run to the main points of the leaf, which, for convenience, have been labelled A, B, C, D and E. These may therefore be called main veins. The next point to notice is the number of subsidiary veins running from the median vein or midrib (that running to C) to points on the leaf margin. It should be observed that the vein running to D, being a main vein, is not counted as a subsidiary vein. The first one to count is that immediately above it, running from the midrib to the margin. All the veins can be seen best from the underside. In Fig. 1, there are five of them, numbered 1-5, each of which may be called a submain vein, and each ends in a point in the margin. It will be noticed that not all the points in the margin receive submain veins. As a matter of fact, they are innervated by veins of a lower order, which branch off from the submain veins. These need not be considered, as they are of no use in identifying the disease. The first character, therefore, in identifying the disease is that a normal leaf has at least five submain veins running from the midrib to a point in the margin. Sometimes the number may run up to seven, but never descends below five. Usually, the submain veins on each side of the midrib are the same in number, though slightly different in position: it is immaterial which side is counted.

(2) The Leaf Margin.—The second point to note is the character of the leaf margin. In normal leaves, such as those shown in Fig. 1, the margin is finely serrated, and there are a number of pointlets which do not receive a submain vein. This may, if necessary, be reduced to a numerical basis, though in practice it is not usually necessary. Thus, on counting the number of pointlets not receiving submain veins between C and the sinus between C and D (marked X), it is found that there are eight. To sum up: the characters that make a perfectly normal leaf are (a) at least five submain veins, and (b) a finely serrated margin with many pointlets not receiving submain veins. To bring out the points of difference, it is best to compare a typical reverted leaf, as shown in Fig. 4. For convenience of reproduction, only half is shown. This type is a very common one in reverted bushes and will be readily recognised by growers. Here the number of submain veins has been reduced to three, and the margin is noticeably coarse in outline. If

one counts the number of pointlets between C and X not receiving submain veins, one finds the number to be two, as against eight in the normal leaf.

There are, therefore, well marked differences. So well marked are they that the practical grower may say that he could tell the difference by eye, without troubling to count. Nevertheless, the method is of value, as can be shown by a consideration of slighter cases of the disease. Fig. 2-7 represent advancing stages of attack. While Fig. 1 is normal, Fig. 2 is slightly attacked, Fig. 3 more so, and so on until an extreme type is reached in Fig. 7. At first sight, Fig. 2 appears normal, especially as it possesses five submain veins. The margin, however, is much more coarsely serrated than Fig. 1, and has only four pointlets between C and X which do not receive submain veins, as compared with eight in Fig. 1. It has, therefore, a distinct touch of reversion in its make-up, and any bush having such leaves is suspect. In Fig. 3, a further stage is represented. Here, only four submain veins are found, and the margin is still coarser, only two uninnervated pointlets being present between C and X. In Fig. 4—the next stage—there are only three submain veins and two uninner-vated pointlets. Fig. 3 and 4 are very common types in cases of reversion. Frequently, no further stage in aberration of leaf type is reached, but sometimes more extreme types are produced, as in Fig. 5-7, where the submain veins are successively reduced to two and a doubtful, two and one. In Fig. 5, the third does not run to the margin, but is twined round in an inward direction. The uninnervated pointlets are reduced to zero in each case. Such types are frequently referred to by growers as "oak leaves." The term is a convenient one, but it must be understood that they grade into the more ordinary types of reverted leaves, of which they are only extreme cases.

It will be observed that in Fig. 1-4 there is a successive comparative elongation of the leaf, which is usually considered by growers to be one of the characters of a reverted leaf. The present writer, however, prefers not to lay emphasis on this character, because though frequently it is a reliable guide, a fuller examination of leaves in the field shows that it is not completely so. One can find cases where reverted leaves are quite broad in shape. The same applies to size. While it is true that in the majority of cases reverted leaves are smaller than normal, it is not always so. For instance, if a

reverted bush grown under good cultural conditions be cut to the ground, the following season's growth has quite large leaves, which, at first sight, appear to be almost normal in shape also, but their reverted state is revealed quickly by the method outlined above. Conversely, small leaves are not necessarily reverted: such leaves, quite normal in character, are produced frequently both at the beginning and at the end of the season.

FIG. 1.

FIG. 2.

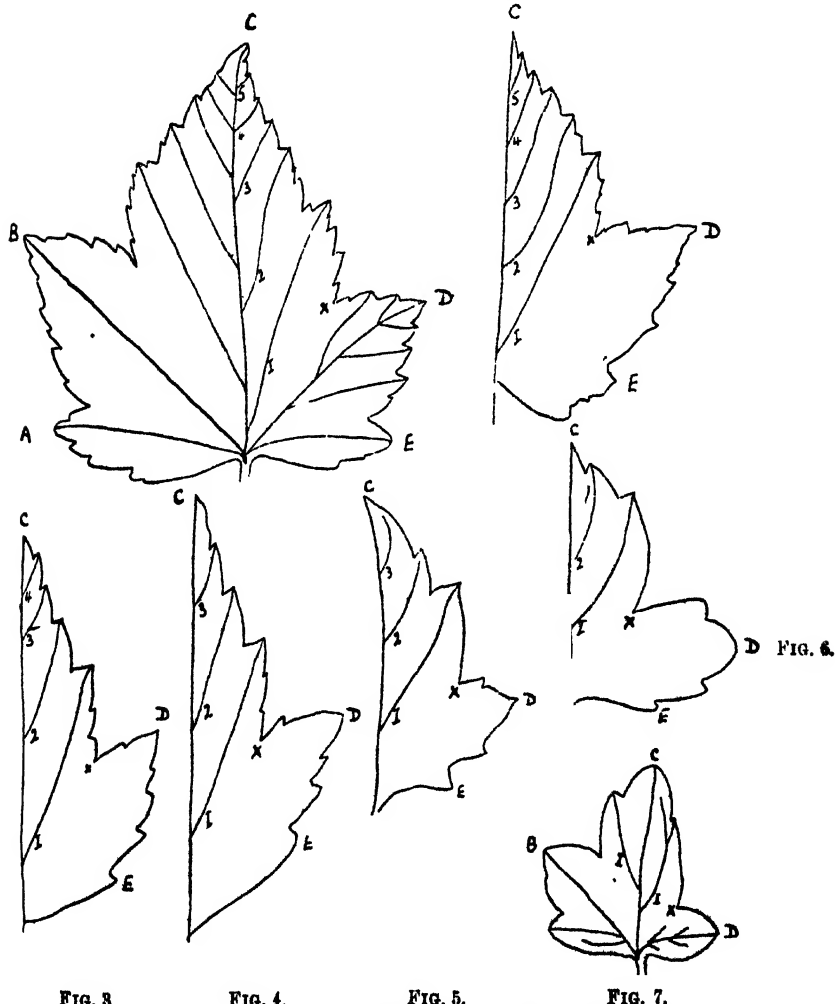


FIG. 3.

FIG. 4.

FIG. 5.

FIG. 7.

Drawings of Blackcurrant Leaves showing successive Stages of Reversion. The numbers indicate Submain Veins.

FIG. 1.—Normal Leaf.

FIG. 2-7.—Successive Stages of Reversion!

For convenience of comparison, the points already discussed have been summarised in the table given below. The method of identification described above has enabled the course of the disease to be followed in considerably more detail and with greater accuracy than hitherto. The results obtained cannot be described here through lack of space, but they show that a reverted bush may start the season by producing perfectly normal leaves. This, however, does not continue long, perhaps only for a few leaves, but it means that in the early part of the season no attempt should be made to identify the disease

TABLE.

Figure.	No. of Submain Veins.	Character of Margin.	Serration	No. of uninnervated pointlets.
1	5	Normal	Fine	8
2	5	Slightly reverted	Fairly fine	4
3	4	Reverted	Coarse	2
4	3	Reverted	Coarse	2
5	2	Intermediate. oak leaf	Very coarse	0
6	2	Oak Leaf	Very coarse	0
7	1	Oak Leaf	Very coarse	0

by this method. By the middle of May, reverted leaves begin to appear, and from this time until the end of June is the period when the disease is most readily recognisable. This fact has long been known to practical growers who do their rogueing at this period of the year. It can, however, be done at any later period until the leaf drops, though the process is not quite so simple. In July or August, the May-June leaves do not show at the top of the bush, and since the reverted leaf type is most marked in May-June, more care must be taken. In many cases, the July-August leaves are also abnormal, and though frequently only to the extent shown by Fig. 2, the grower who has trained his eye by the method described in this paper will soon be able to pick out such leaves. All he has to do is to turn back the branches and look for the leaves produced in May-June. If reversion is present, the leaves will show it quite clearly.

Practical Conclusions.—As mentioned above, in the present state of knowledge regarding the disease, the grower has two methods of attack. The first consists of propagation from sound

stock. Now while nurseries in general do their best to send out sound stock, cases have occurred in which reverted bushes have been received from firms of established reputation. This statement is not made in destructive criticism, for the writer is fully aware of the great difficulties experienced by firms in ridding their stock of traces of the disease. But the risk still remains, and is proved by the fact that no firm dare give a guarantee that the stock they send out is free from reversion. There is also a further point to consider, that in the present scarcity of nursery blackcurrants, a grower cannot always obtain the variety he wants. It is, therefore, important that he should be in a position to propagate from his own stock, if he so wishes. In such a case, he should examine his stock in June and mark down individual bushes which, proved by the method described above, are absolutely sound. It is useless as well as dangerous to mark down blocks of bushes unless every bush is inspected, because in a block that appears normal there are frequently some which on closer examination show a trace of the disease. It is best to be on the safe side by using only those that are beyond suspicion. Such bushes should be denuded of every scrap of wood that will serve for a cutting.

The second process of control open to the grower is roqueuing. This should begin in the cutting beds and end in the plantation. In June of every year, the cutting beds should be examined and every affected bush grubbed and burned. Exactly the same procedure should be adopted in the plantation, except that, since the bushes are fruiting, they should be marked then for destruction after the fruit has been picked. The best method of marking is to break one or more small branches in such a way that they are not completely removed; the dead leaves indicate the disease and the operation does not materially interfere with the crop. By adopting these methods, one large fruit grower has practically eliminated the disease from his plantations.

THE BREEDING AND REARING OF TURKEYS.

C. A. FLATT.

THE breeding of turkeys has long been recognised as an industry of considerable importance in Europe, mainly in France and the southern countries, from which prior to 1914, large and increasing quantities were imported annually to the English markets. Very few data are available as to the extent of turkey breeding, and except that the average turkey population per hundred acres of cultivated land was 2.3 in England and Wales, and 7.2 for Ireland in the year 1908, no reliable figures can be quoted.

Origin of the Turkey.—The origin of the domestic turkey was for some time a subject of controversy, but it is now accepted generally that our domestic varieties are descendents of the North American wild breeds, *Meleagris Americana*, and *M. Mexicana*. The former is a large bird with dark and bronze markings, while the latter is of smaller build, shorter in the leg and with white tipped plumage. It is more than probable that turkeys were first introduced into Europe through Spain, and it is claimed that domestication dates back 500 years. In any case there is evidence of demand for these birds for the table over three centuries ago, and if the earliest specimens first reached Spain they would speedily become distributed throughout Europe at this period.

Breeds.—The most common and popular variety in Great Britain is that known as the American Bronze, and there is no doubt that this breed and the Cambridge Bronze possess the blood of the *M. Americana*, or wild turkey of the more northern climes of America, while the origin of the White or Buff varieties, which are less popular in Great Britain, is probably more directly traceable to the *M. Mexicana*. These breeds, together with the Black Norfolk turkey which is now seldom seen, are the only distinct varieties known in this country. Both the American and the Cambridge Bronze are of large size, and they probably owe this and their superior claim to vigour to the more recent introduction of wild blood. The Black Norfolk, at one time most justly popular for its quality of flesh and propensity to

fatten easily, might clearly be claimed as a purely English variety of the turkey, but owing to lack of care in breeding, very few specimens of this breed are now to be found. While the White turkey alternately termed the "Austrian," and in America the "Holland," is to some extent bred in this country, it does not enjoy the popularity of the Bronze. It has frequently been stated that the White turkey is delicate constitutionally, but this is largely prejudice, and the real explanation of its lack of popularity is probably to be found in its smaller size compared with the Bronze. In reality it is a hardy bird of very good table quality. The Buff turkey has no special claims for the attention of breeders for market purposes.

The Present Position.—Turkey breeding has been slowly but steadily increasing in England and Wales, but to meet the growing demand the increase of imported birds from Ireland and from Europe has been far greater in proportion. During the war period the breeding of turkeys declined, both in this country and in Europe, indeed in some of the southern countries it must have almost ceased, and until the past season of 1920 the importation of foreign turkeys for the Christmas markets was at a very low level. Rapid recovery in breeding can be made as with all classes of poultry stock, and although there was no evidence of a renewal by a return of Italian and Austrian turkeys to our markets, the supplies from France last Christmas exceeded early expectations. In England there was evidence of a considerable increase in rearing during 1920. Large quantities of birds came from Ireland last Christmastide, although the unsettled conditions in that country upset and probably decreased the supplies.

The uncertainty of the supplies available, and the inflated ideas of values resulted in the fixing of a higher value on the turkey last Christmas than the public would pay, and in spite of their popularity at this season, the high price seriously affected the demand for turkeys. The producers had been misled to some extent by the buyers who were anxious to ensure supplies for their more wealthy customers irrespective of cost. The sudden fall in price at the last moment was due largely to the holding up of supplies for the sake of the high prices, and the result was unfortunate for some, while others reaped the benefit. With the gradual return to more normal conditions and prices, it is to be anticipated that the demand will become more measurable and steady, and the apparent slump which occurred this season cannot be taken as an indication of over production.

Turkey rearing is a suitable branch of poultry keeping for many farmers and smallholders, and provided it receives the careful attention which is necessary, turkeys are a most profitable crop. For many years turkey breeding has been practised on a considerable scale on farms in the eastern counties, mainly Norfolk and Cambridgeshire, and the bulk of the finest English turkeys come from this area. With the exception of Devonshire, turkey breeding and rearing cannot be said to be practised generally by farmers in any other part of England, and although in Devon many turkeys are reared, the individual flocks are smaller. This is no doubt due to the smaller area of the farms, and the different nature of the general farming operations.

Conditions Suitable.—While it can be accepted generally that turkeys will thrive better under the drier climate and upon the warmer more freely drained lands of East Anglia, suitable conditions are by no means confined to the counties in which the best of our English turkeys are produced. In North Devon the ruling conditions are exactly the opposite, yet a large quantity of very fine birds are produced here. The intelligent attention which has been given, and the longer experience which has been gained in the subject in the eastern counties is chiefly accountable for superior results. The turkey is more hardy than is conceded generally, and while a dry soil and natural protection from driving rains and cold winds are a necessary condition to the most successful results, the same applies to the keeping of the ordinary fowl, with this difference: Such adverse conditions can be overcome to a large extent with the keeping of fowls, by the adoption of more intensive measures, and the provision of artificial protection. In the case of the turkey this cannot be advocated, as the most essential condition to turkey breeding and rearing is an unrestricted range.

The lighter and better drained soils are a distinct advantage because they are warmer and sweeten more rapidly. Natural shelter is desirable, such as that afforded by woods and thick hedges, but it by no means follows that valleys and low lying ground are preferable, although they may be better protected, since these are frequently damp, and the land at a high altitude which appears to be exposed, will often lend itself better to turkey breeding.

Turkey Breeding.—The practice of keeping a stag turkey with three or four hens is to be seen frequently; this is to be deprecated. The initial cost and maintenance of a stag for this

small number of hens is not economical, in addition to which it is sometimes detrimental to the hens, and frequently an inferior specimen is used in order to avoid the cost of purchasing a more suitable stag bird. Probably this practice is due to the difficulty in securing hatching eggs at a reasonable price; on the other hand there is a failure in many instances to recognise the true value of the hatching egg from carefully selected stock. The difficulty has been overcome to some extent in Ireland by the provision of stud turkeys, and in Scotland by the establishment of stations for the supply of hatching eggs, and has resulted in the breeding of a hardier stock, and a reduction in mortality from the specially selected stock which are secured for the purpose of these schemes. The breeding of turkeys is most profitably carried out by the general farmer who is in a position, if desired, to rear a large flock from his breeding stock. The small holder or specialist poultry farmer, with more intensive methods of utilising the land at his disposal, cannot provide the space and conditions so desirable for a flock of breeding turkeys; the actual breeding can therefore be far better carried out upon farms where unlimited range and natural cover is available for the birds during the greater part of the year. The sale of hatching eggs offers a very profitable field for the farmer.

A turkey stag should be mated to at least 10 hens, and frequently a flock of 15-20 hens can be run with a vigorous bird. A breeding flock of this size is seldom a practical proposition to the small holder or to anyone rearing turkeys in small numbers, unless a trade in hatching eggs is intended. Rearers of small flocks of turkeys would be generally better advised to purchase eggs for hatching, if these are obtainable in the locality at a reasonable price, than to keep adult stock themselves for breeding purposes, unless they are able to arrange to keep two or three hens and take them to stud, but the first is the better alternative in most cases.

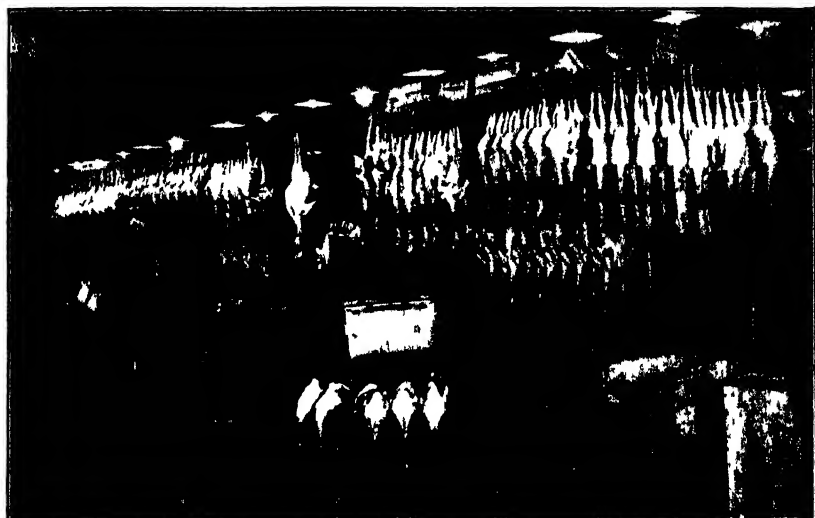
Management.—Careful attention is required in the selection and management of the breeding stock, and there is no doubt that much of the delicacy and losses in the young turkeys is due to carelessness in the selection and treatment of the parent birds. The turkey is an intermittent feeder and dependent upon food from natural sources to a greater extent than the fowl, and as a result the condition of the breeding flock is liable to suffer considerably on a limited range, or to anything approaching poultry soured land. The breeding flock should be kept as far as possible under open air conditions. It is

advisable to provide some roosting shelter during the worst months of the year, for which purpose an open cart shed is very suitable. On the other hand, in order to keep the birds away from the yards, or from the neighbourhood of other poultry stock, it is frequently better to provide a house in the vicinity of a copse, or a stackyard where the birds can obtain shelter from wind and rain.

A very simple affair is required as a roost. A framework of rough timber with a thatched roof, and three sides composed of faggots, furze or broom, or of straw, bracken or similar material packed between two layers of wire netting, will suffice. The fourth side should always be open to the air, preferably facing south, and covered with netting for protection against foxes, and for the purpose of controlling the birds in order to save time in finding the eggs. Even if the hens cannot be persuaded to lay in the house, they are more easily tracked to their nests if confined until the attendant arrives to liberate them in the morning. During the summer and autumn months the birds will be better roosting in the trees, and only for their protection from enemies and control for the owners' convenience need a roost house be provided.

The birds are not full grown until 18 months to 2 years of age, and, therefore, at their best for breeding at about this age. Turkeys can be used for this purpose at 10 to 12 months, although it is preferable to use a more mature bird of one sex to mate with young birds of the other. If poults are used the stag bird should not exceed 25 lb. weight, which is small for a 2nd year bird. As an average a male of the Bronze breed weighing 20 lb. to 25 lb. and hens of from 14-16 lb. in the commencement of their first season are desirable, but it is most important that the birds should not have undergone any special preparation in fattening for table before they are set aside for breeding purposes. Every care should be taken to select neat, strong but fine boned birds which are bright and active.

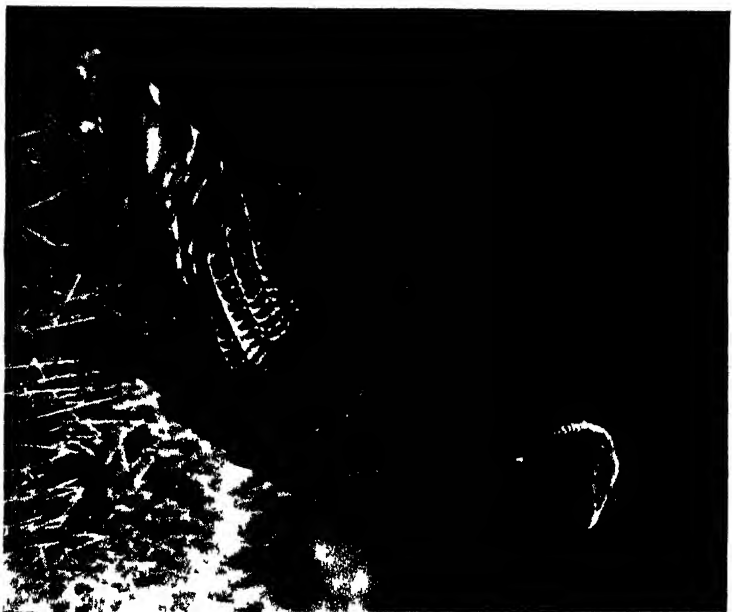
Rearing.—Turkey rearing should not be lightly undertaken; the young birds require intelligent and careful attention for the first eight to ten weeks, and it is questionable whether the time spent in rearing a few birds could not be better employed. A flock of 50 birds takes up very little, if any, more time in attention than one of half the size, and in consequence the labour charge is approximately reduced. Losses in rearing, apart from those due to careless breeding already mentioned, often occur



Display of Irish turkeys in Smithfield Market The centre Bird weighs 25 lb



Group of Turkeys reared at Tattingstone, Suffolk. The Birds were hatched on 16th June, 1920, and when marketed at Christmas the average Weight of 27 Stags was 19.9 lb and of 40 Hens 13.2 lb. The heaviest Stag weighed 22.5 lb and the heaviest Hen 15 lb. The Price received for the whole Consignment was 2s. 10d per lb nett (plucked)



Young Turkey Stag, weight 25 lb.



Young Turkey Hen, weight 15 lb.

through faulty feeding. The young turkeys cannot contend with a large proportion of starchy food. Considerable quantities of green food are required, and this is better if secured in the natural way, although it is necessary to chop it finely and incorporate with the other food when given to the earlier hatches in the first stage.

Food is required only in small quantities at frequent intervals, and although the general methods adopted for chicken rearing can be advocated, a too free use of dry chick mixtures or of scalded biscuit meal cannot be recommended. If biscuit meal is used, it should be squeezed dry and curds given with it. Rice which has been boiled or baked in separated milk is one of the most healthy foods if a proportion of green food is given with it, but this is still better if boiled in the liquid from boiled nettles. Variety is necessary, but the turkey chicks are fastidious feeders, and do not always take a change of food readily; for this reason the use of a small quantity of chopped onion, of which they are generally very fond, mixed with the food, can be recommended. Many young birds die from affections of the liver, and although it should not be thought that the use of medicines of any description is considered generally necessary, signs of sluggishness in the birds may often be corrected with the use of Epsom salts in solution mixed with the meals; on the other hand, upon any symptoms of diarrhoea, a weak solution of catechu (10 gr. to 1 gal.) or sulphate of iron ($\frac{1}{2}$ oz. to 1 gal.) should be added to the drinking water.

The liberal supply of chopped green food already advised applies more particularly to the earlier hatches. When hatching is carried out in May or June the turkey chicks will have better opportunity of securing ample supplies from natural sources.

Late hatching has much in its favour when the birds are only required for table purposes, the warmer and drier months of May and June and the greater abundance of natural food make rearing easier.

An instance of the results which can be secured with late hatched birds is given in the accompanying plate.

Fresh ground upon which to rear the young turkeys is most essential, and a favourite practice is to cut walks in a field of clover on which to place the coops.

Young turkeys suffer to a considerable extent from damp, and from bad ventilation, due to the inadequate accommodation in coops and houses. Turkey coops of large size should always be used in preference to the ordinary hen coop, even though the

rearing is done by a hen. A hen coop may be large enough for 7 or 8 young turkeys for the first week, but they outgrow this long before it is time to remove the mother hen, and the larger coop is not of sufficient size to accommodate the young birds for very long after the hen is taken away. A small open fronted chicken house is probably the most economical for the hen and turkey chicks; this affords ample shelter in bad weather for the chicks, and the accommodation will suffice until the stage when roosting in the open air will be the most satisfactory method, provided there is no risk from foxes or other enemies.

The risk from exposure to wet and cold winds is greatly reduced after the turkeys have reached ten or twelve weeks old, and an ample supply of fresh air in the sleeping quarters, if the provision of these is found necessary, is of chief importance. Unless given a wide range, from this stage onwards, the cost of feeding will be heavy. Facilities for placing the birds upon the stubbles following harvest go a considerable way towards the making of a good profit. In the past it was no uncommon practice for farmers to buy young turkeys in the autumn for placing on the stubbles, finishing them for the Christmas markets, and this proved very profitable. The birds came chiefly from Ireland, but the improved knowledge of the Irish rearers and better facilities for marketing has induced them to market their produce first hand, by which they reap greater benefit. Many birds of the finest quality are now supplied from Ireland.

Marketing.—It should be the chief aim of the producer to secure the trade in the best quality of produce. The English breeder is in a favourable position to market his turkeys in the best possible condition, but will find a keen competitor in Normandy which sends turkeys of very fine quality to the English market. The Irish turkey is undoubtedly the most formidable rival of the English bird of second grade. Of recent years the demand has been for smaller turkeys, and size to some extent has become of secondary importance to quality. The levelling of the price per lb. for large and small birds is an advantage to the producer since it has effected the raising of the price per lb. of the small to that of the larger bird. Even then, provided the quality of the birds are equal, the smaller bird is better value to the consumer. The increase in demand for the smaller birds is, therefore, generally in favour of the growers as the percentage of very large birds is not high. Whether the trade is in large or small birds, quality will have its effect upon the price secured, and it is to the interest of the producer to offer birds of the best type.

For a month or six weeks before Christmas the young turkeys should be specially well fed, but any sudden change of food avoided. Whereas up to this period the birds will have been to a large extent gleaning their own living, supplemented with corn feeding during the final process, barley meal, middlings and ground oats should now be given in a crumbly mash. Maize meal may also be given, but since this has a tendency to lay on yellow fat, only small quantities should be used. The use of separated milk or butter milk for mixing the meal is to be recommended during the final period, and during the last 10 days rough fat which has been reduced by boiling, can be added to the mash. Meat offal may be used occasionally during this period; it should be boiled, chopped small and mixed with the meals, and will frequently serve to stimulate the birds when they show lack of appetite.

The confinement of turkeys while fattening cannot be advocated, and although this and the process of cramming is sometimes adopted for the production of show specimens, it is not recommended for ordinary commercial purposes. Special care should be taken in preparing the birds for market. Turkeys are killed frequently a week or ten days before Christmas, and a preliminary fast of from 24 to 36 hours is necessary. Not only does this free the body from undigested matter, but the blood will drain more freely from the vessels, leaving the flesh a better colour, and the carcass will cool more rapidly, all of which adds to its keeping quality. Turkeys are killed either by piercing the brain with a knife and bleeding through the mouth, or by dislocation of the skull from the neck, when the blood drains into the space. The latter method is preferable from all points of view if properly carried out.

The skin of the turkey is very tender, and care should be exercised both in plucking and in packing to prevent tearing or bruising, which greatly detracts from the appearance. A few feathers are frequently left on the back for the protection of the skin, and it is usual to leave the small feathers at the tip of the wing and the top of the neck; the carcass should otherwise be plucked clean. It is essential that the carcass should be completely chilled before it is packed for sending to market. Large hampers are most suitable when any quantity is to be sent by rail. These are supplied by some of the Railway Companies, and by salesmen for consignments which are intended for them. Clean straw should be used in packing, and it is an advantage to tie white paper round the body of the birds for better protection.

Attention to details which lead to the more attractive appearance of the produce, and the employment of methods required by the particular market supplied, are well worth any additional trouble. It is necessary that the English producer should study the markets' requirements if he is to retain hold of them, and with the improvement in organisation which would come about with increased attention to turkey rearing, this would become a most profitable section upon many more farms.

WOMEN IN HORTICULTURE.

FUTURE PROSPECTS.

KATE BARRATT, D.Sc.

ABOUT thirty years ago, women began to take up gardening as a serious occupation and a means of earning a livelihood. For the few pioneers, faced with prejudices of all kinds, it was uphill work, but gradually, as more and more women were trained, a steadily increasing number found posts as practical gardeners. The majority of these were occupied in private gardens, some as head gardeners, others as assistants. A few made a success of jobbing work in the suburbs of London; others were occupied in nursery or market gardens as owners or employees. Among the women who, from their love of plants and their desire for an outdoor life, had been attracted to horticulture as a profession, were some who became keenly interested in the scientific aspects of the work. These found an outlet for their energies in the teaching profession, and, after a scientific training, obtained posts on the staffs of various schools and colleges. This side of the work, which was naturally attractive to some, offered in addition better remuneration than the purely practical posts.

Soon after the outbreak of war, when the men joined H.M. Forces, those women who had been trained in practical gardening found a rapidly enlarging field for their activities. One of the results of this rather sudden and big demand for women gardeners was the rapid dilution of skilled workers by a number of insufficiently trained women. There is some reason for believing that this influx of semi-skilled labour has reacted unfavourably on the prospects of women gardeners under post-war conditions. Many have found it difficult to obtain positions in competition with men. The rise in the cost of living, consequent upon the War, has had its effect upon horticulture. It has resulted in a drastic reduction in the staffs of many gardens, while the increased rate of wages and a reduction in hours of work has caused many employers to dispense with their women gardeners. Men are undoubtedly better equipped physically for heavy labour than are women, and this has become a very important factor in weighing their respective merits.

In many private gardens, also, the War directly effected the shifting of the centre of interest from the purely decorative to the commercial side. Although many, perhaps most, of the

large ornamental gardens of the country are still carefully maintained, in many others the fruit and vegetable gardens are now expected to bring in some return. On the other hand, market gardening benefited from the general rise in food prices, and has become a far more important branch of the profession than formerly, although at the present time the prices of vegetables to the grower scarcely cover the cost of cultivation.

The two factors mentioned have directly affected the employment of women. In commercial work, although a certain standard of quality must necessarily be maintained, quantity of production is of greater importance, and it is here that the physical disabilities of women prove a handicap in competition with men.

A consideration of these facts points to the necessity of women devoting themselves to those branches of horticultural work for which they are best suited. They must specialise in those directions in which their lack of physical strength imposes least handicap, and in which they have opportunities of exhibiting the special aptitudes of their sex. They must always be prepared to offer the advantage of quality in their work to compensate for the possible lack of quantity. There are certain branches of gardening for which women are specially qualified—for example, propagating work, packing produce, handling seed, glass-house work, flower and bulb cultivation. The remuneration offered to practical workers is not high, and, at the best of times, only provides a living wage, so that it is necessary to find compensation in the delight of an open air life amidst congenial surroundings.

The various openings for women in horticulture may be classified under several heads:—

1. Private Gardens.—There is still a limited demand for women as gardeners in private establishments, and this demand will probably always exist. While in some cases the woman is engaged on account of her practical ability, in others the employers are themselves women and prefer the advantages which result from the companionship of an educated woman as gardener. The wages offered average from 80s. a week for an inexperienced girl just out of college to 50s. or 60s. with cottage, vegetables, &c., for a head gardener. It is necessary for the woman gardener to be devoted to her work, for the life is often a solitary one, with continuous hard work and very little holiday. Without experiencing the joys which gardening brings to real lovers of gardens, the woman gardener's life would be unbearable.

2. Nursery Work.—This is a branch of horticulture which offers an opening to a limited number of women as employees. The bulk of nursery work will always fall to men, for the reasons already stated; the average man is capable of a greater output of manual labour, and is, therefore, certain to be employed in preference to a woman for most purposes. Women, however, have shown a very decided aptitude for certain sides of the work, especially in the many processes concerned with propagation. They learn quickly, and they are dexterous as well as careful in their manipulation. It is clear that if women are to succeed at this kind of work, they must be thoroughly interested in it and spare no efforts to perfect their skill in the practical operations, because there will only be room for those who show themselves superior in technique to the average man. The wages offered are very similar to those paid in private gardens, and here, also, responsibilities carry an increased wage.

3. Small-holdings, Fruit and Market Gardens.—At the present time this department of horticulture is being explored and tested by women. Opportunities for obtaining the initial experience are still rather difficult to find, apart from the instruction given in various schools and colleges. Many women were employed in market gardens while the men were on Active Service; others joined the Land Army and obtained varied experience in farm work. A few of the latter are now starting small holdings of their own, either independently or in co-operation. The progress of some of the experimental colonies recently projected will be watched with profound interest, because, if successful, they will point a way in which suitably equipped women may find a useful and congenial occupation. This branch of horticulture, however, can only be open to those with sufficient capital to start ventures of their own and provide outside labour for the heavy work. Further, it demands other qualities than those required by an employee in a nursery or private garden. For clearly the grower should have some bent towards commercial life. No doubt, however, the development of co-operative buying and selling will help those who have but little experience of business methods. The small-holder, therefore, requires considerable all-round ability, since it must be remembered that she has always to face the risk of losing her capital.

4. Suitable Employment for Trained Women.—The majority of women gardeners have been drawn from the ranks of educated women, and have received their early training in a college in a scientific atmosphere. Hence it is not surprising to find that a small proportion of them have been sufficiently

interested in the scientific aspects of the work to seek further training and to find employment in which they could utilize the knowledge thus acquired. The openings in this direction have developed very much in recent years, and offer a splendid field for women with a love for the work and the necessary ability to carry it out. They may be grouped as follows:—

(a) *Teachers in Schools and Colleges.*—The demand for women teachers has always been greater than the supply. This is due largely to the fact that no special courses of training have been arranged for students wishing to take up teaching work. Students desiring to teach gardening, together with such subjects as botany and nature study, have taken the ordinary course at a horticultural college and followed it up by further study at a university. This has meant a very long period of training which has been possible only to a few. A considerable shortening of the time involved might be effected if some of the horticultural colleges already providing a good all-round practical training, combined with this a more extended course suitable for the preparation of teachers of gardening, and the theoretical subjects associated with it. At present, the majority of teachers of botany in girls' schools receive an academic training in a college, which is usually situated in a town, with little or no opportunity of acquiring a practical knowledge of the living plant. Surely it would be far better for these women to receive their theoretical instruction at an institution which can also illustrate and develop theory in the field and garden. Teachers thus equipped would be able to bring new ideals and a new standard to the teaching of botany in schools, and could foster in their pupils that love and understanding of gardening and rural pursuits which is so desirable.

(b) *Instructors and Inspectors in Horticulture.*—The educative value of gardening in rural schools is now generally admitted, and in order to extend it many county councils have appointed instructors and inspectors in horticulture. Their duties vary in different parts of the country, but generally they are expected to instruct in school gardening, to keep in touch with rural schools, to give help and advice in educational questions touching their subject, and frequently to give lectures and demonstrations to adults. Several women have already been appointed to such posts, and there is no reason why more should not fit themselves for the work. It demands a wide experience of practical horticulture as well as a sound knowledge of the fundamental scientific principles underlying it.

(c) *Research Work.*—Finally, there are openings for women

in horticultural research work. Women with the necessary training, who have a keen interest in such scientific problems as plant-breeding, plant pathology and physiology can now find opportunities to carry out investigations in these subjects. It must, however, be pointed out that research workers are required to be of a high order of efficiency; they should be highly trained botanists and chemists, and, in addition, they should have had a practical training in horticulture. The woman gardener who has the ability and can afford to undertake the necessary scientific training should prove eminently suitable for such work.

There remains one question which deserves consideration, and that is the type of woman who is likely to "make good" as a practical gardener. Before the War, women gardeners were almost without exception drawn from the educated classes. This was due to the fact that the necessary practical training could only be obtained at a college or gardening school, and was, consequently, restricted to those who could afford to pay the fees. Incidentally, the colleges were obliged to devote a considerable part of their courses to the teaching of elementary garden operations. Such knowledge was acquired by boys and improvers at no expense to themselves. The War, however, introduced new conditions which react in two ways on the entry of women into horticulture. In the first place, it opened the door of many gardens to women as learners and improvers, with the result that it is now possible for them to obtain the initial *practical* training outside the colleges and schools. It is to be hoped that this will have a marked effect on the work of the gardening schools in the future by raising the grade of instruction given and ensuring that it shall be of a more advanced and specialised character. In the second place, the necessities of war produced a new type of woman gardener. Large numbers of working class girls were attracted to the Land Army and experienced the joys of a life in the open. Some of them continued their work and are still employed in nurseries and private gardens. These women may become imbued with a desire to learn something of the scientific principles underlying the manual operations which they are carrying out. If so, the need can be met in two ways, (1) by the provision of suitable instruction at the developing Farm Institutes, and (2) by the establishment of bursaries and scholarships tenable at the recognised gardening colleges and awarded only to those women already in the profession who cannot afford a scientific course.

WITHER-TIP AND BROWN ROT OF PLUMS.

THE decay of ripe plums known as Brown Rot is a disease familiar to all growers. It is a serious trouble wherever this fruit is cultivated, and the losses due to the disease, both on the trees and in market consignments, are often very heavy. The attack by the Brown Rot fungus on the flowers and shoots of the Plum Tree, which is known as "Blossom-Wilt and Wither-Tip" respectively is quite as serious, and at times more serious, and has only recently been recognised and carefully studied. The details of the various Brown Rot fungi and their method of attack have been followed with extreme care and minuteness by Dr. H. Wormald, of Wye College, to whom practically the whole of our knowledge of Brown Rots, as they occur on fruit trees in this country, is due, and on whose work this article is based.

The fungus concerned in the various attacks on plums is *Monilia cinerea*, forma *pruni*. It is a form of this same species (*M. cinerea*, forma *muli*) which causes the Blossom-Wilt of apple. The two forms, however, are quite distinct. The plum form is apparently unable to cause Blossom-Wilt of apples and the apple form has not been found on plums. This should be a matter of considerable satisfaction to growers when the number of apple orchards interplanted with plums is considered.

Brown Rot of cherries is caused by the same fungus as Brown Rot of plums, and in this case, also, it attacks the blossom and the wood as well as the fruit. The description given in this article, and also the control measures recommended, would apply equally to cherries.

Blossom-Wilt.—The Brown-Rot fungus produces a Blossom-Wilt of plums similar to that found on apples (see Leaflet 312). In the spring, spores derived from the mummied plums on the trees, and from spore-pustules on infected wood, are blown on to the flowers. The spores readily infect the stigma, and the mycelium of the fungus passes down the style and causes the death of the flowers (Fig. 1 and 2). The mycelium subsequently passes through the flower-stalk into the wood and attacks the



FIG. 1.—Blossom with flowers, which was incultured 30 days previously, shows the style prominent as to turn (left).



FIG. 2.—Flower 9 days after



FIG. 3.—Flower 10 days after

WITHER-TIP AND BROWN ROT OF PLUMS.

THE decay of ripe plums known as Brown Rot is a disease familiar to all growers. It is a serious trouble wherever this fruit is cultivated, and the losses due to the disease, both on the trees and in market consignments, are often very heavy. The attack by the Brown Rot fungus on the flowers and shoots of the Plum Tree, which is known as " Blossom-Wilt and Wither-Tip " respectively is quite as serious, and at times more serious, and has only recently been recognised and carefully studied. The details of the various Brown Rot fungi and their method of attack have been followed with extreme care and minuteness by Dr. H. Wormald, of Wye College, to whom practically the whole of our knowledge of Brown Rots, as they occur on fruit trees in this country, is due, and on whose work this article is based.

The fungus concerned in the various attacks on plums is *Monilia cinerea*, forma *pruni*. It is a form of this same species (*M. cinerea*, forma *mali*) which causes the Blossom-Wilt of apple. The two forms, however, are quite distinct. The plum form is apparently unable to cause Blossom-Wilt of apples and the apple form has not been found on plums. This should be a matter of considerable satisfaction to growers when the number of apple orchards interplanted with plums is considered.

Brown Rot of cherries is caused by the same fungus as Brown Rot of plums, and in this case, also, it attacks the blossom and the wood as well as the fruit. The description given in this article, and also the control measures recommended, would apply equally to cherries.

Blossom-Wilt.—The Brown-Rot fungus produces a Blossom-Wilt of plums similar to that found on apples (see Leaflet 312). In the spring, spores derived from the mummied plums on the trees, and from spore-pustules on infected wood, are blown on to the flowers. The spores readily infect the stigma, and the mycelium of the fungus passes down the style and causes the death of the flowers (Fig. 1 and 2). The mycelium subsequently passes through the flower-stalk into the wood and attacks the



FIG. 1.—Blossom Wilt. The lower flower, which was in an early stage previously, shows the bluish meniscus to turn black.



FIG. 2.—The same 9 days after in culture. The calyx lobes of the lower flower have collapsed and the stems have withered completely.



FIG. 3.—A typical specimen of Withered Tip. Infected in the lower leaf on the left and extending into the shoot used the wilting of the terminal portion.

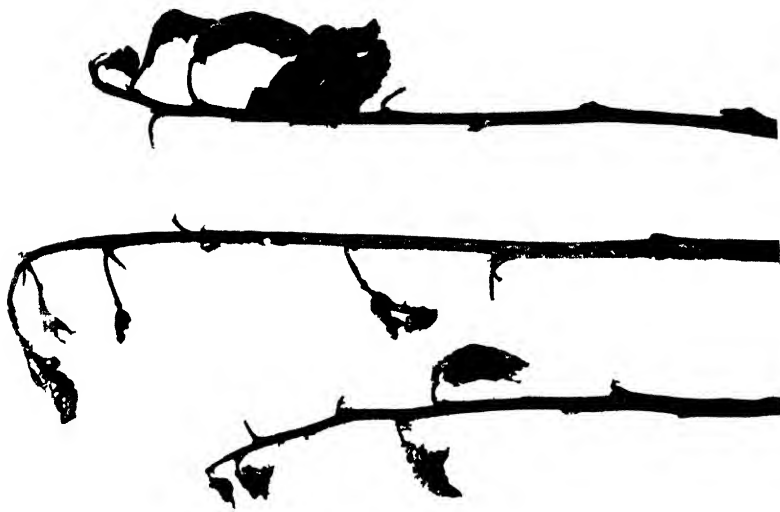


FIG. 4.—Withered Tip is seen in winter and spring showing the dead leaves which often remain attached, and the spotted stalks (especially on the shoot to the left).



FIG. 5.—Mummied plum. The pus-tules in the center plum are beginning to become active and produce spores.



FIG. 6.—Brown Rot. Showing the death of a young plum caused by the Brown Rot fungus and the subsequent infection by means of direct contact, of the healthy plum. Spore-pustules are abundant on the dead plum.

shoots. Trees which have suffered from Blossom-Wilt may be recognised by the brown, withered leaves which usually remain attached instead of falling off.

The damage caused by Blossom-Wilt is very serious in certain seasons. The factors chiefly contributing to an epidemic attack are a low temperature, and a very moist atmosphere during the flowering period. The former retards the development of the flowers, and causes them to remain susceptible to infection for a longer period than usual, and the latter favours the production, by means of the pustules on mummied fruit and dead wood, of an abundance of spores.

Wither-Tip.—In Wither-Tip the fungus attacks the young green shoots and causes them to die-back. In this way many of the leading shoots are killed, and the buds at the base are then stimulated to precocious development, and instead of fruit buds, a number of weak, ill-ripened shoots are produced.

The Wither-Tip form arises from spores formed on the spore-pustules on mummies, on wood attacked the previous season, and probably also from flowers killed by Blossom-Wilt. It usually appears about the end of April or the beginning of May, when some of the young shoots may be seen to wither. The wilt does not always begin at the tip of the shoot; it may commence some distance down, the fungus in this case entering at a node or through a leaf. In Figure 3, the dark portion of the shoot shows the infected area, the fungus having gained infection through the leaf on the left. Shoots attacked by Wither-Tip hang downwards; at first they are flaccid, but later the tissues harden and dry, and the dead shoots may be recognised by the characteristic curve. The dead brown leaves, being killed prematurely, do not usually fall from the tree, but hang on during winter and even until spring (Fig. 4). When it is a spur that is invaded the fungus sometimes forms a canker similar to that formed in apples.

Spore-pustules develop during the following winter and spring, on all the shoots and spurs which have been killed (Fig. 4, specimen to left), and these give off spores which provide for the fresh infection in spring. The pustules are small and grey in colour, they commence to show in December, and increase in number as spring advances. Large quantities of spores are liberated in March, April and May. The fungus in dead twigs may retain its vitality for more than one season, and liberate a crop of spores during the second winter after attack. The importance, therefore, of removing such shoots is obvious.

The severity of Wither-Tip is greater in some seasons than in others. Wet, cold weather in spring favours its development, but since epidemics of Wither-Tip have been found to correspond with severe attacks of aphids, it is possible there may be a connection between them. The aphides, by puncturing the leaves, would injure the tissues, and render them particularly susceptible to invasion by the fungus mycelium.

Brown Rot on Fruit.—The fruit is more often attacked when approaching maturity, the slightest wound or bruise allowing the spores to penetrate and bring about infection. Once it has gained an entrance the mycelium rapidly destroys the fruit, and finally reduces it to the hard, wrinkled structure known as a "mummy." The mummies may fall to the ground, but usually they remain on the tree until spring, stuck together in groups of two or three by means of the fungus mycelium (Fig. 5).

Although it is on ripe or nearly ripe fruit that Brown Rot is best known it may also attack young fruits. These may be infected by direct contact with mummies or with other diseased fruit (Fig. 6), but apart from this it is clear that wounds or abrasions of the surface are necessary for infection. Soon after the fruits are infected, small grey spore-pustules appear, often in concentric rings.* The spores liberated from these pustules infect other fruits. When the fruit is destroyed, and the dry mummy stage is reached, the pustules for the most part cease forming spores and remain dormant till spring, when they regain their activity, liberate myriads of spores, and thus bring about new attacks of Blossom-Wilt and Wither-Tip.

Varietal Susceptibility.—With regard to Blossom-Wilt and Wither-Tip, as a general rule Victoria and Czar Plums suffer most. In 1920 the attack on these varieties in East Anglia was particularly severe, and it was estimated that 80 per cent. of the flowers and shoots were killed in certain districts. Later in the season the trees made new growth but this was very weak, and on Victoria especially much of it was subsequently killed. Occasionally Monarch Plums suffer more extensively than either of the above. Pond's Seedling and River's Early are not usually so severely attacked.

The fruit-rot form is common on all varieties, although if trees are extensively affected with Blossom-Wilt and Wither-Tip the likelihood of the fruit becoming attacked by Brown Rot is greater.

* It may be noted that Apple Brown Rot (*M. fructigena*) which is distinguished by its buff instead of grey pustules, is sometimes found on ripe plums causing a rot. It appears, however, to be confined to such fruit and not to attack flowers or shoots.

Control Measures.—At present there are three methods of treatment, as indicated below :—

(a) *Removal of affected fruits and mummies.*—It cannot be understood too clearly that new infections are mainly brought about by the mummies hanging on the trees, and by diseased twigs. Diseased and decayed plums should therefore be picked and dropped to the ground at the same time as the crop is gathered. Any mummies that are left on the tree should be removed in winter before the buds swell. They should be collected and burned or deeply buried.

(b) *Cutting out of diseased shoots.*—As far as possible all dead twigs bearing pustules should be cut out, and if the attack is not extensive it will be possible to do this without excessive labour or serious injury to the trees. If large areas are concerned the labour is of course prohibitive, and the trees may be injured through excessive cutting out. At the same time, it should be remembered that the affected wood is quite dead, and therefore useless.

(c) *Spraying.*—In spraying the aim is to destroy the spore-pustules on the wood by means of a caustic winter wash, but the treatment is only in an experimental stage. The chief difficulty is to wet the pustules thoroughly, as on account of their powdery nature, the spraying fluid runs off. This can partly be overcome by the addition of soft soap. The mixture which has proved most promising is as follows :—

1 lb. caustic soda.

1 lb. soft soap.

10 gal. water.

The best time for applying a winter wash depends to some extent upon the season. It should be applied as late as possible, but not too late to run the risk of damaging the opening buds. Generally speaking, the correct time is about the end of February or the beginning of March, but in a cold, late season the spraying might be delayed until the end of March.

POTATO DISEASE (BLIGHT) IN 1920.

THE continual wet weather of the summer of 1920 gave rise to fears (not unfounded) that there would be a very severe outbreak of Blight, with considerably lessened production in consequence. That these fears were not confirmed to the full appears to be due to the fact that the wet was accompanied by continued cold. Once again it was found that excessive wet alone is not sufficient to cause a "Blight year"; a high temperature is also necessary if the fungus is to become rampant. Volkart,* in a Swiss paper states that the fungus (*Phytophthora infestans*) does not develop and spread until the temperature attains 20° C. (68° F.), and this is borne out by seasons such as the present.

The first signs of the disease in the South West were observed in the Penzance district as early as 30th April, and it was fairly general there by the second week in May. By June it had attacked the main crops and by July it was prevalent throughout Cornwall, many parts of Devon and Dorset, and was appearing in Somerset. In the meantime it appeared in other districts, especially in Lincolnshire (one exceptional case was reported the third week in April) and by the middle of June it was of common occurrence, and in July it was present throughout most of the country.

In low-lying and marshy districts, especially where sea mists are common, so that there is almost constantly a damp atmosphere, the disease was bad. Such areas were noticed in 1920 in both Lincolnshire and Sussex.

On the higher grounds in Lincolnshire and elsewhere the disease was later in appearing and not so bad when it did appear. The same applied further north, although disease became very bad towards the end of the season in Lancashire. This was especially the case on heavy soils, and disease in such cases considerably reduced the crop, which was already poor owing to difficulty of cultivating and late planting due to continued wet. On the other hand, disease was not as evident on the lighter soils, and as the wet season suited these, heavy crops largely free from blight were obtained. It was a general occurrence this season to find that, notwithstanding the almost universal appearance of blight on the haulms, the tubers from light soils were remarkably free, while on the heavy soils the trouble was so prevalent on the tubers as severely to reduce the crop and make clamping almost impossible owing to the further risk of rotting.

On the whole very little spraying was done. Owing to varying

* A. Volkart, Landw. Jahrb. d. Schweiz., Jahrg. 33, 1919, p. 38 [Abs. in Centr. f. Bakt. 51, 1920].



UN-SPRAYED

SPRAYED TWICE

Field of Potatoes in Pevensy, Sussex, showing the Un-sprayed and Sprayed Haulms

and conflicting reports, more especially as to the scorching of haulms, and the fact that it was difficult to get machines and materials, very few allotment holders sprayed at all. When spraying was carried out on allotments it appeared successful, but owing to the absence of "controls" the freedom from blight may have been due to other causes. Against this may be set the fact that many cases of success were noted by Inspectors where there were "controls" or adjoining fields for comparison.

In Bedfordshire, in a field of potatoes which had been sprayed twice, the haulms were green long after those of the unsprayed crops of neighbouring farms had died down. It is worth mentioning that in this county, dry spraying is said to be successful, although if water is readily available, a wet spray seems to give slightly better results. Good results were noted in Lincolnshire where a large number of growers spray, and they find that increased crops result. In Kent also, the spraying of potatoes is largely practised by farmers, and here again, sprayed fields remain green much longer than unsprayed fields and give a bigger and cleaner crop. Unsprayed haulms were reported to have gone off as early as the first week in August. A fair amount of spraying is done in East Sussex, and approximately 25 per cent of the farmers are said to spray their potatoes. The illustration of a field of potatoes in Pevensy, taken about the end of September last, shows the bare stems in the unsprayed portion of the field, and the green haulms in the other part of the field which had been sprayed twice.

There is need for attention to be given in the South Western districts, which are particularly liable to blight, to the selection of varieties more or less resistant. Notwithstanding repeated statements that blight-free varieties exist, no variety has yet been discovered which is immune from this disease. There is, however, a varying resistance under ordinary conditions of which more use might be made. It is well known that Up-to-Date and British Queen are particularly susceptible, and in 1920 Duke of York was reported as taking Blight badly in Lincolnshire. On the other hand, the President type (President, Iron Duke, Scottish Farmer), Northern Star type (Northern Star, Allies, Ajax), Evergood, Kerr's Pink, Templar, Arran Victory, Irish Chieftain, Golden Wonder, Champion, Flourball and Shamrock, all show more or less resistance to this disease, and where suitable should be planted. In cases where the soil is heavy and wet, second earlies such as Great Scot, Royal Kidney, Ally. &c., should be planted so that they can be lifted and clamped dry before the autumn rains set in.

DEPUTATION FROM THE PARLIAMENTARY COMMITTEE OF THE TRADE UNION CONGRESS.

ON 8th February, Sir Arthur Griffith-Boscawen, M.P., received a Deputation from the Parliamentary Committee of the Trade Union Congress when Mr. R. B. Walker drew attention to the following Resolution of the Congress:—

“ That this Congress while recognising that the land problem cannot be effectively dealt with outside national ownership and control, nevertheless believes that immediate steps should be taken to secure the compulsory cultivation of all agricultural land.”

Mr. Walker declared that more than 240,000 acres had gone out of cultivation in 1920, while 480,000 acres had gone out of cultivation in two years. In passing, he criticised the effective representation of labour on certain of the Agricultural County Committees, and then pointed out that there had been a large reduction in the number of farm labourers since 1911. He claimed, too, that since 1903, in spite of the Small Holdings Act that came five years later, the number of small holdings in this country showed an actual decline from 433,000 to 417,000. In conclusion, he asked (1) for more extended cultivation, (2) for further investigation into wheat growing, (3) for stricter supervision over acts of husbandry, (4) for a vigorous housing policy.

In reply, Sir Arthur Griffith-Boscawen pointed out that the term “ out of cultivation ” was very carelessly applied by many people who used it. Cultivation was often meant to imply arable cultivation, but unless that was the limited sense in which the term was used by Mr. R. B. Walker, he would like to say that land had not gone out of cultivation; indeed there was very little uncultivated land in this country. Land properly laid down to grass could not be described as having gone out of cultivation. A certain amount of land awaited reclamation, but the Ministry's experiences showed that this reclamation might exceed the value of the land reclaimed. With regard to the shrinkage in the area under cultivation in the broadest sense, it was well to remember that urban England and Wales were extending their boundaries day by day, month by month and year by year; where the field is the outskirts of the town to-day the suburb will replace it to-morrow,

and in purely rural centres the factory appears suddenly in the midst of fields shortly to be the centre of a colony of houses built to house the workers. So, while industry grows and the area of our island kingdom remains stationary, there is a steady and cumulative inroad upon the cultivable area. As far as proper acts of husbandry are concerned, he looked to the Agriculture Act to set up a higher standard than exists at present, for that was its object and that will be its aim. Guaranteed prices for wheat and oats, and compensation for disturbance would prove but of little value to farmers whose acts of husbandry were not above suspicion, and he thought that Agricultural Committees would be justly critical of their county's effort. Farmers who did not cultivate according to the new and much stricter definition of good husbandry would get neither the guaranteed prices nor the compensation for disturbance. The Government desired, and the Ministry of Agriculture had pursued, a policy of extended arable cultivation. Both wished to see a much higher percentage of land under the plough, and to this end they had instituted a policy of stimulation, since Parliament would not renew the compulsory powers contained in the Corn Production Act. It should be remembered that the Act only guarantees farmers against serious loss; it does not, and cannot guarantee them a profit on their corn-growing, and consequently the farmer has to look at the situation with an eye that embraces the triple factor of prices, wages and hours. Unfortunately, the decline in prices, the rise in wages and the diminution of hours had re-acted upon the farmer and many now were playing for safety. But, while the Ministry admitted the danger of this safety policy being carried too far, and was working hopefully to restore the proper balance between arable and grass, this could only be obtained by giving the farmer confidence. Compulsion would never serve, because it was impossible to compel any man to carry on business at a loss, and if the farmer would not extend his tillage by reason of the danger to his solvency, there was nobody to do it for him. The State could not and would not turn farmer. The Premier's statement at the Caxton Hall, to which Mr. Walker had referred, applied not only to arable but to grass, but whatever the needs or desires of the country might be, it was impossible for the Ministry to overlook the economic factor. There were only two ways by which this factor could be ruled out. The first was by a heavy subsidy to the farmer; the second was by a heavy tariff on

imported wheat. Needless to say, the country at large would accept neither, and consequently the Ministry's policy must be to improve the standard of husbandry and so retard the return to grass, while seeing that the grass itself was raised to a high standard of feeding value. A campaign of practical instruction, in which demonstration plots played a large part, was in active operation.

Land Settlement and Small Holdings.—Mr. Walker had pointed out in connection with this question that the small holdings were fewer in 1903 than they were in 1920, but small holdings and small holders, too, were dependent upon economic forces and thousands of small holdings which were situated in the neighbourhood of towns in 1903 were to-day, in 1921, a part of those towns, their very existence forgotten. So far as the Government Land Settlement Scheme was concerned, it should be remembered in fairness to those who had borne the burden of the work, that down to 1919 the Ministry had very small powers indeed. A short eighteen months ago the Land Settlement (Facilities) Act cleared the road, and since then they had been buying land, parcelling it out and putting up houses and farm buildings. Their record in the face of building difficulties well known to all present, was one of which there was no reason to be ashamed. Already 12,431 men had been settled; 16,373 additional applicants had been approved and were taking settlement, and it was expected that there were 5,700 more to be settled, or 34,500 in all—in England and Wales. Of this very considerable number, in the face of all the difficulties attending upon getting work done, more than one-third were settled on holdings averaging about 18½ acres per man. The equipment averaged about £350 per settlement and the total area of land acquired for settlement was 350 square miles.

Continuing, he pointed out that there are two sides to the small holding question, and both required careful consideration by those who represent the worker. Small holdings in many cases have dispossessed the farmer, and, with the farmer, those who worked for him. While on a highly cultivated mixed farm of, say, 400 acres, a dozen or fifteen men might be employed, when that farm was taken, as in certain cases it had been necessary to take it for small holdings, the workers, as well as the farmer, were dispossessed. The ex-Service man was not only granted a holding at a rent he can reasonably be expected to pay, the cost of purchase or hire and equipment of land being paid out of the Government grant of 20 millions, but he was entitled

to borrow from the County Council for the purpose of stocking his holding £1 for every £1 of his own, up to £500. In this way his settlement was facilitated further. Another point that he would emphasise was that land that had been bought for settlement was representative of the best land in England. It had been the Ministry's care to select soil on which the small holder might make good, and consequently, whatever changes there might be in settlement, the land would always offer a living to those who worked upon it wisely and with a will. In counties where land for small holdings had been badly chosen in years past, derelict fields and deserted buildings alone remained.

In reply to a question from a member of the Deputation who enquired whether the Ministry of Agriculture issued information on agricultural subjects, Sir Daniel Hall pointed out that every aspect of agricultural activity is dealt with in leaflets, which are issued free of charge, not only to farmers but to every applicant who is concerned with working the soil of this country to obtain any sort of return. Sir Arthur Boscawen added that, in his opinion, the best way in the long run to help agriculture was by the promotion of research to acquire new knowledge and by dissemination of that knowledge among farmers and others who work on the land.

NOTES ON MANURES FOR MARCH.

E. J. RUSSELL, D.Sc., F.R.S.,

Rothamsted Experimental Station, Harpenden, Herts.

Lime.—Correspondence in regard to lime is still abundant, and again it must be urged that lime or limestone must be applied to sour arable land before satisfactory improvement can be effected. In many districts drainage is equally necessary, and money is wasted if expended upon lime without drainage. In other districts, as on the flinty clays of the Home Counties, lime or chalk is quite sufficient. The effect is being shown in a marked way at the present time on the Rothamsted fields, the soil of which is a sticky, heavy loam. Plots and fields that have received chalk are in a favourable workable condition; those that have not are sticky. Usually the difference in crop is less than might be expected, excepting in the case of clover which has to remain throughout the winter in whatever conditions exist, and suffers accordingly. There is a marked difference in ease of working in spring. It is impossible to obtain reliable figures as to cost from plots, but there can be little doubt that a good dressing of chalk saves spring cultivations for a number of years.

There is usually reliable local information on these matters; the point of the present note is to urge that *no substitute is known for liming or chalking of arable land*. On pasture land basic slag often proves more satisfactory, and to that extent may be considered as a substitute.

Between lime, limestone and chalk the choice is determined partly by soil and partly by convenience:—

(1) On heavy soils all are equally effective, but lime is the most concentrated, and therefore often the most economical. In the Home Counties, however, chalk is often found the most economical.

(2) On light soils ground chalk or limestone is often safer than lime, as less loss of valuable organic matter results therefrom.

(3) On peat soils lime is more economical than limestone or chalk owing to transport costs.

Importance of Slag and of Lime in ensuring an Early Start of Young Seeds.—An interesting experiment at Rothamsted, commenced for another purpose, has incidentally afforded an admirable illustration of the value of basic slag and lime in stimulating growth of clover where sown in a corn crop (in this instance barley), and thereby ensuring a satisfactory plant. In the control experiments the young clover made the usual start, but on the plots receiving slag and lime the plant was much

better and made approximately twice as much growth *without in any way interfering with the barley*. The slag was applied in the spring. Frequent complaints are received at Rothamsted of the failure of young seeds; many causes no doubt operate, but shortage of lime and phosphate is probably a frequent source of trouble. In such cases application of lime and slag offers a method of dealing with the problem which is both simple and effective.

Spring Dressings of Nitrogenous Fertilisers on Oats.—In last month's Notes it was shown that spring dressings of nitrogenous fertilisers benefit the wheat crop; other experiments show that such dressings are of great advantage to the oat crop also. For example, in 1919 the following results were obtained at Rothamsted. The *grain* yielded in bushels per acre was :—

<i>Top dressing.</i>	<i>Expt. A.</i>	<i>Expt. B.</i>
None	64	49
Sulphate of ammonia	80	63
Nitrate of soda	72	69

while the yield of *straw* in cwt. per acre was :—

<i>Top dressing.</i>	<i>Expt. A.</i>	<i>Expt. B.</i>
None	30½	25½
Sulphate of ammonia	40½	34
Nitrate of soda	41½	38

The gain from the use of the sulphate of ammonia or the nitrate of soda is very evident both in grain and in straw.

Nitrolim as Fertiliser.—Enquiries are being made as to the proper use of nitrolim. When applied to arable land it should be put in with the seed and *not used as a top dressing*. During the War some attempts were made on the Continent to obtain satisfactory results from top dressings of nitrolim, but they were not successful. Similarly in this country a few trials have been made of the effect of nitrolim in top dressings, but nothing useful was obtained. In one case a mixture to be cut for green food was used as the test crop. Some of the results from equal areas were :—

No nitrolim	66½ cwt.
Nitrolim as top dressing	66½ „
Nitrate of soda	70½ „

On grass cut for hay, increased crops have been obtained so long as the material is applied sufficiently early; thus at Rothamsted the yields were :—

No nitrolim	27 cwt. hay per acre.
Nitrolim	32 „

Elsewhere, in another experiment *where it was applied late*, no increase was obtained. No fertiliser can be expected to act unless it is properly used, and all experience shows that the proper use of nitrolim is to work it early into the soil and not use too late.

FEEDING STUFFS IN MARCH.

E. T. HALNAN, M.A.,

Ministry of Agriculture and Fisheries.

WHEN purchasing a feeding stuff two items generally are considered by the prospective buyer, namely, the food value and the residual manurial value. For this reason the buyer requires a guide which includes both values, and these will be found in the table on p. 1155.

The method adopted of valuing feeding stuffs is as follows:—

The price of the feeding stuff is obtained* (col. 2); the manurial value is then ascertained (col. 3), and is based on the residual manurial value of the nitrogen, phosphoric acid and potash present in the feeding stuff. This value remains constant so long as the unit value of manures remains approximately constant; there is no necessity to take notice of minor fluctuations. The food value (col. 4) is arrived at by deducting the manurial value from the purchase price, and by dividing the food value by the starch equivalent (col. 5), the price per unit of the starch equivalent (col. 6) is obtained.

The unit of starch equivalent represents the food value of one-hundredth part of a ton, and divided by 22.4 will give the price per lb. of starch equivalent (col. 7). This column is a useful guide in assessing the relative values of all feeding stuffs given in the table.

Comparison of present prices with those published in last month's *Journal* shows a further reduction, and groundnut cake, palm kernel cake and decorticated cotton cake now appear to be comparatively cheap feeding stuffs. In view of the coming spring a purchase of common cotton cake is recommended, as the use of this cake will be found desirable to alleviate scour in cattle turned out to grass.

Several readers lately have written as to the value of different varieties of maize and its by-products for feeding purposes. At the present time there are two types on the market (either whole or as a meal), known as round and flat maize; the flat type has a feeding value about 1 per cent. higher than the round. Yellow and white varieties of maize of the same type have the same feeding value. In America the flat varieties are known as "dent corn" and the round as "flint corn"; the former, however, are almost exclusively used for feeding stock.

* The prices quoted in the table are ex mill or store, and do not include transport charges and dealers' commission, which vary in different districts. Readers are advised to calculate the values in accordance with the note at the end of the table. The prices were those current at the end of January.

NAME.	Price per Qr.		Price per Ton.		Manurial Value per Ton.	Food Value per Ton.		Starch Equiv. per 100 lb.	Price per Unit, Starch Equiv.		Price per lb. Starch Equiv.
	s.	lb.	£	s.	£	s.	£	s.	s.	d.	
Barley, English Feeding	51/9	400	14	10	1	6	13	4	71	3/9	2.01
" Foreign	52/6	400	14	14	1	6	13	8	71	3/9	2.01
Oats, English	45/6	336	15	3	1	9	13	14	59.5	4/7	2.45
" Foreign	34/2	320	11	19	1	9	10	10	59.5	3/6	1.87
Maize	55/-	480	12	17	1	5	11	12	81	2/10	1.52
Beans, English spring	—	—	—	—	—	—	—	—	—	—	—
" " winter	70/-	532	14	15	3	1	11	14	66	3/6	1.87
" Chinese	—	—	—	—	—	—	—	—	—	—	—
Peas, English blue	68/-	504	15	2	2	13	12	9	69	3/7	1.92
" " dun	78/-	504	17	7	2	13	14	14	69	4/3	2.28
" " maple	78/-	504	17	7	2	13	14	14	69	4/3	2.28
" Japanese*	180/-	504	28	18	2	13	26	5	69	7/7	4.06
Buckwheat	74/-	392	21	3	1	9	19	14	53	7/5	4.06
Rye, English*	68/6	480	16	0	1	8	14	12	72	4/1	2.19
Millers' offals—Bran	—	—	13	10	2	10	11	0	45	4/11	2.63
" " Coarse middlings	—	—	14	10	2	10	12	0	64	3/9	2.01
Barley meal	—	—	20	0	1	6	18	14	71	5/3	2.81
Maize " "	—	—	13	10	1	5	12	5	81	3/-	1.61
Bean " "	—	—	19	0	3	1	15	19	66	4/10	2.59
Fish " "	—	—	22	0	7	12	14	8	53	5/5	2.90
Linseed " "	—	—	17	0	2	16	14	4	119	2/5	1.29
Cakes, Linseed	—	—	17	0	3	12	13	8	74	3/7	1.92
" Soya	—	—	—	—	—	—	—	—	—	—	—
" Cotton seed	—	—	10	0	3	5	6	15	42	3/2	1.70
" Cotton seed de-corticated*	—	—	19	0	5	6	13	14	71	3/10	2.05
" " decorticated meal	—	—	16	0	5	6	10	14	71	3/-	1.61
Coconut cake	—	—	10	5	3	0	7	5	79	1/10	0.98
Groundnut cake	—	—	16	0	3	9	12	11	57	4/5	2.37
" " decorticated*	—	—	16	0	5	5	10	15	73	2/11	1.56
Palm kernel cake*	—	—	7	10	2	1	5	9	75	1/5	0.76
" " meal	—	—	7	0	2	1	4	19	75	1/4	0.71
Brewers' grains, dry	—	—	8	5	2	7	5	18	49	2/5	1.29
" " wet	—	—	1	15	0	12	1	3	15	1/6	0.80
Distillers' " dry	—	—	11	10	2	16	8	14	57	3/1	1.65
" " wet	—	—	—	—	—	—	—	—	—	—	—
Malt culms	—	—	7	10	3	6	4	4	43	1/11	1.03
Potatoes	—	—	2	19	0	8	2	11	18	2/10	1.52
Swedes	—	—	1	5	0	5	1	0	7	2/10	1.52
Mangold	—	—	1	3	0	6	0	17	6	2/10	1.52
Vetch and oat silage	—	—	2	15	0	15	2	0	14	2/10	1.52

* Prices at Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in the larger markets, usually London, and refer to the price ex mill or store. They are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. Its manurial value is 22 ls. per ton. The food value per ton is therefore £7 10s. per ton. Dividing this figure by 75, the starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 1d. Dividing this again by 22.4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1.11d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market.

One class of meal is obtained by grinding the whole maize, but the other has the embryo and hull removed during the process of grinding. As the embryo contains a large proportion of oil present in the grain, the whole meal is preferable; consequently, in his own interest, the buyer should ascertain what class of meal he is purchasing before concluding the bargain. In future the writer will deal each month with one of the more important feeding stuffs and its by-products, priority being given to those on which correspondents have expressed a wish for information.

It is possible this year that breeders of live stock, particularly milk producers, will be able to rear a number of their better class calves with a view to retaining them in the herd. In doing this they will sacrifice an immediate profit which they would have obtained by selling the whole milk consumed by the calves, but the profit will be realised eventually in the value of the cow or store produced. Some useful information on calf rearing, with due regard to the necessity for economy in the use of whole milk, is given in Leaflet No. 142.

Occasionally a raw egg beaten up in the calf mixture given during the early weeks of the calf's life is a valuable addition. Eggs are rich in all the vitamins considered essential for the young growing animals, and their use occasionally is strongly recommended on this account.

NOTES ON POULTRY KEEPING.

Fall in Prices of Eggs and of Feeding Stuff.—Poultry keepers may gather some consolation for the recent rapid fall in the price of eggs from the fact that the wholesale prices of feeding stuffs have also fallen considerably during recent weeks on the London market (see table).

				<i>Price, week ended</i>			
				<i>3rd Nov., 1920.</i>		<i>16th Feb., 1921.</i>	
				£	s.	£	s.
Wheat (British Feeding)	...	per 504 lb.		4	11	3	5
Barley "	"	400 lb.		4	5	1	16
Oats (English)	...	336 lb.		2	19	2	1
Fish Meal	...	ton		25	0	22	0
Barley Meal	...	"		25	0	17	15
Maize Meal	...			19	0	12	17
Coarse Middlings (British)				15	10	12	10
Bran (British)...	...			14	10	11	10
Fine Middlings (Imported)				20	10	14	10
Pollards (Imported)	...			15	15	11	0

NOTE.—The prices of meals and offals given above are not for less than 2 ton lots ex-mill or store.

The average fall in price for all the feeding stuffs shown is approximately 29 per cent. from the beginning of November to the middle of February. Barley meal and maize meal have fallen £7 5s. and £6 8s. per ton, or 29 and 33 per cent., respectively, whilst the price of fine imported middlings has fallen nearly 30 per cent., and English oats and pollards also show a fall of about 30 per cent. With the exception of English barley, which is usually only used to any extent for poultry feeding by the general farmer, all these feeding stuffs figure largely in the poultry keeper's feeding stuffs bill.

On the other hand the average price of best British eggs has fallen from 5s. 2½d. per dozen for the week ending 3rd November, 1920, to 3s. 6d. per dozen for the week ending 16th February, 1921, a reduction of 1s. 8½d. per dozen or 33 per cent. The price of eggs usually falls at this season of the year, but the fall this year has been much greater than in the corresponding period of 1919-20. The average price for the week ending 5th November, 1919, was 5s. 0½d. per dozen, and for the week ending 18th February, 1920, 3s. 10½d. per dozen. a reduction of 1s. 2d. per dozen or 28 per cent.

It is estimated by leading poultry farmers that the cost of feeding stuffs constitutes about 60 per cent. of the total charges

against production. It is desirable, therefore, that all possible economy should be practised in this direction with the object of cheapening production. The possibilities of obtaining high egg production by using feeding stuffs of an inferior quality were explored to some extent during the War, and although the results obtained in some cases were surprisingly good, further experiment is required in this direction before definite recommendations can be made. The inferior feeding stuffs used during the War period have now fallen out of favour and are replaced generally by good meal and grain. Even palm kernel meal which was used to a considerable extent has not gained in popularity, though it is a distinctly useful food for poultry if used in moderate proportions, namely, 10 to 15 per cent. It is also comparatively cheap. The tendency at one time to a freer use of clover meal has apparently ceased. The rise in the price of this material was not accompanied by an increase in quality, but rather the reverse. Where clover meal of good quality and reasonable price can be obtained, however, its value as a food for laying hens deserves close attention. Fortunately fish meal has improved in quality and the present price makes it a cheap form of animal food for poultry. Substitutes, such as bracken root meal, dried tomato skins, seaweed meal, &c., which were tried during the War, are now receiving little attention. The cost of such substitutes and the results obtainable from them require to be carefully investigated before any recommendation could be made regarding their use.

The specialist egg farmer is the producer most likely to feel the effect of the fall in egg prices, because he has to purchase practically the whole of the food requirements for his birds, whilst the general farmer, whose birds are able to find more of their food from foraging over the land, is in a more favourable position in this respect. The specialist producer, however, not only secures usually a larger proportion of eggs in the winter months when prices are high, but also as a rule adopts more productive methods of feeding. The bulk of the eggs produced in this country are probably produced on ordinary agricultural holdings, but considerably increased production from farm poultry could be obtained, particularly in the winter months, if farmers were to adopt more efficient methods of feeding. The aim should be so to supplement the food obtained by the birds in foraging that they may receive a sufficient and properly balanced ration. Many farmers buy no special food for their poultry, which are fed entirely on the products of the farm. Up

to a point this is a sound principle, but it frequently results in indifferent egg production. Laying poultry require some form of animal food, especially during the winter months, and happily the use of fish meal for pig feeding and calf rearing is in some cases now extended to farm poultry. Fish meal is one of the most valuable foods for egg production, and should be regularly used in the proportion of 10 to 15 per cent. by weight of the total food given to the birds.

Maize is an excellent grain for poultry and might well be even more widely used than it is at present. It appears, however, to suit poultry better when cracked than when given whole.

Chicken Rearing.—The cost of rearing is usually a heavy item for poultry keepers who are unable to provide their chickens with ample fresh ground. During the rearing season there is an abundance of natural food on suitable land provided it is not too heavily stocked. The poultry keeper would frequently find it cheaper to increase the area of land for rearing than to overstock the land available. The extra rent paid would be counterbalanced by the saving in food, and at the same time the chickens would thrive better. There is a heavy annual depreciation in the value of a laying bird as the cost of rearing is in any case high, and this depreciation should be reduced as far as possible in view of a further possible fall in egg prices.

There is a considerable tendency to use unsuitable and unnecessarily expensive ingredients in the feeding of chickens, and this is particularly noticeable in the case of certain dry chick foods. Variety in feeding is a distinct advantage, but this may be secured at the expense of economy. Three of the most valuable ingredients for dry chick food are probably cracked wheat, cracked maize and groats or coarse oatmeal. Animal food such as meat meal or fish meal is not really essential for chickens for the first fortnight of their lives. Millet is frequently used to a large extent in proprietary mixtures, but is not usually eaten readily by the chickens. Rice, if used at all, is better given in a cooked form, especially when the chicks suffer from diarrhoea. The following simple mixture is an example of a dry chick food which is comparatively inexpensive and easy to make up, and which will be found quite satisfactory in practice:—

3 parts by weight Cracked Wheat.

1 " " Cracked Maize.

1 " " Groats or Coarse Oatmeal.

4 or 5 per cent. of linseed, which will assist the chicks in feathering, or a similar quantity of hempseed may be included

in cold weather. If the litter in the brooder is kept clean a small quantity of this mixture may be scattered on the floor once or twice daily, and this will keep the birds actively employed when they have to take shelter from bad weather.

Various methods of feeding chickens are adopted by poultry keepers with equal success, and there is little justification for stating that any one system is the best. Probably the system which includes the use of dry chick feed, a dry mash, and a wet mash is as good as any. A suitable dry mash may be made up as follows:—

- 2 lb. Bran.
- 2 lb. Middlings.
- 1 lb. Sussex Ground Oats.
- 1 lb. Maize Meal.
- $\frac{1}{2}$ lb. Fish Meal.

To this mixture some poultry keepers add 4 per cent. of fine charcoal. Good wet mashes may be made up of:—

1. Boiled Rice and Middlings in equal parts by weight,
2. Biscuit Meal " " '
3. Middlings 2 parts, Sussex Ground Oats 1 part, Maize Meal 1 part,

with the addition of 10 per cent. of meat or fish meal after the chicks are a fortnight old. The wet mash should be made up with boiling water and given in a crumbly condition.

The dry mash should be fed in a shallow hopper which can be opened or shut by the poultry keeper according to the periods when he desires the chickens to take this food.

A simple system of feeding is to give the birds a meal of the wet mash as early in the morning as practicable. About 10 o'clock a little dry chick feed may be scattered amongst the bedding. At mid-day the dry mash hopper may be opened for the remainder of the day and in the mid-afternoon a little more dry feed may be scattered in the bedding. If desired a further feed of wet mash may be given for the last meal at night, but this is not necessary. Very young chicks require to be fed at frequent intervals, the object being to keep the birds active, bright and thriving. As they grow older the number of meals should be reduced, but the poultry keeper should bear in mind that the less the chicks are kept under hot-house conditions the better, and that provided they have access to a warm dry brooder whenever they require it, the more they are encouraged to take exercise in the open air, even in the early season, the better they will thrive.

AGRICULTURE ABROAD.

KEEPING FARM ACCOUNTS—FIRING OF HAYSTACKS.

In every course of agricultural education the question of accounting arises, whether large-scale or small-scale farming is undertaken. The United States Department of Agriculture has recently issued an interesting pamphlet* dealing with this matter, in which is outlined a method of analysing the farm business with a view to determining the investment, expenses and profits. It is pointed out that farming accounts may be grouped into two classes: (1) those pertaining to the farm business as a whole, or financial accounts, and (2) those relating to an analysis of the various enterprises, commonly called detailed cost accounts.

The aim of the publication is to show the farmer how he may arrive at an analysis of his business as a whole. This analysis is based on preliminary accounts tabulating labour and other records of all items, as well as the records of costs incurred in feeding live stock. The entire system is finally brought down to a table called the Farm Summary, which groups totals of the detailed accounts under the heads of Investment, Farm Receipts, Farm Expenses, Farm Income, Interest on Investment, Labour Income, Value of Operator's Labour, Percentage Return on Investment, and Value of Items for Family Use. The first three headings are again sub-divided into three, viz., *Investment*, comprising Real Estate, Live Stock, Machinery and Equipment, Food and Supplies and Cash to Run the Farm; (2) *Farm Receipts*, comprising Live Stock Increase, Other Sources, and Increase in Food and Supplies; (3) *Farm Expenses*, comprising Current Costs, Unpaid Family Labour, Decrease in Live Stock, Depreciation and Decrease in Food and Supplies.

To arrive at the investment result, the average of the investment at the beginning and at the end of the farm year may be taken, or merely the investment at the beginning of the year, whichever more nearly represents the true capital invested in the year's business. The choice is governed by

* Farmers' Bull. No. 1139, "A method of analysing the Farm Business."

conditions on individual farms. If real estate improvements are made, additional equipment purchased or additional live stock added early in the year and used in the year's business, the average of the investment at the beginning and end of the farm year should be used. Should such changes in investment have occurred late in the year, the amount at the beginning of the year will probably represent more nearly the capital from that year's business. The total under the five subordinate heads already mentioned will give the entire farm investment on which interest should be charged.

Under *Receipts* the sum of the four subordinate groups will represent the total receipts of the farm, and in like manner, the items which fall under the general heading of *Expenses* will show the position for total outgoings. Farm Income is arrived at by subtracting the total expenses from the total receipts, the result giving the total money receipt for the use of capital and workmen's wages. In calculating Labour Income, it must be remembered that capital has an earning power which at least equals the current rate of interest on well-secured farm loans. Interest at this rate deducted from the farm income gives the farmer's labour income. This last represents the amount of money remaining to the farmer after paying all business expenses and deducting interest on the money invested in the business. In addition to the labour income, the farmer has the use of the farmhouse and products such as fruit, garden vegetables, dairy produce and fuel, that are furnished by his land towards his living. The difference between receipts and expenses will not necessarily correspond to the money in hand or in the bank, as personal and living expenses have to be paid out of this amount. A further deduction will be interest on mortgage or other debts, together with any principal paid.

The object of this record is to ascertain how much the farmer makes, not how much he actually saves. After the farm return is known, the responsibility rests with the farmer himself as to how much he will spend personally or use in other ways. There must be a proper relation between all the different classes of work carried on, and account keeping will enable farmers to ascertain at once and with accuracy which of their undertakings are successful, and which unsuccessful.

AN interesting article on the firing of haystacks, by G. Laupper, of Zurich, appears in the Swiss Agricultural Yearbook for 1920. After a short historical discussion the author gives a very exhaustive account of all the papers bearing on the subject, and concludes his article with a useful bibliography. In the light of the newer facts elucidated as a result of recent research, the following account may be given as to the probable causes of the firing of haystacks:—

**The Firing
of Haystacks.**

Four Phases in the Heating of Haystacks.—In the heating of haystacks four successive phases may be distinguished. In Phase 1, the hay sweats, and a temperature of 50°C. (122°F.) is reached, generally within two days. The hay then passes into Phase 2. Sweating increases, much vapour is given off, together with an aromatic smell, and the hay becomes a light brown colour. A temperature of 70°C. (158°F.) is reached, usually in about a week.

Phases 1 and 2 are considered desirable in the making of hay. The heating in Phase 1 is due to the respiratory activity of the plant cells; the heating in Phase 2 is variously attributed by authors to bacterial action, ferment activity, and the catalytic action of combinations of iron and manganese. The exact cause of this heating is not yet clear, and further research on the subject appears to be necessary, especially in view of the importance of controlling this phase in order to prevent the onset of Phases 3 and 4.

In Phase 3 the temperature increases to 90°C. (194°F.), a dark brown hay is produced, and much vapour is given off, together with a pungent smell. The causes which lead to rise of temperature in this and the succeeding phase are entirely chemical in origin. A fortnight to three weeks may elapse from the beginning to the end of Phase 3.

Phase 4 culminates in combustion, and is a very dangerous period. The temperature from 90°C. (194°F.) to ignition point may be reached within two hours. The phase consists of a damp distillation followed by dry distillation. Gases are given off, a pungent and slightly burning smell may be detected and the hay rapidly carbonises. Hay which has reached this phase without eventually firing has a black-brown or black colour, and has lost most of its nutritive value.

It has also been shown that heating in the stack is most liable to occur with young grasses containing a large proportion of water-soluble material. In other words, the most

nutritive grasses and clovers require most care in conversion into hay. In heating, too, the losses fall on the water-soluble material, i.e., that part of the hay of best feeding value.

Points to be noted in Making and Stacking Hay.—The practical points of most interest to the farmer arising out of the results of these researches are:—

- (1) In making hay, the better the quality of the forage dealt with the more care is necessary in curing the hay and building the stack in order to avoid undue heating.
 - (2) The heating of a stack is not due entirely to the presence of moisture. As is shown above, the amount of water-soluble material present plays a very important part. Of two stacks built under similar conditions, one of poor grass and one of good quality grass, the good quality stack may easily overheat, whereas the poor grass stack may not, although the same amount of moisture may be present in both. It also follows that rain-washed hay, when made up into a stack, rarely overheats, even when got under unfavourable conditions.
 - (3) In hay making, the chief aim of the farmer should be to cure the hay at the lowest possible temperature. High temperatures in the stacks mean considerable loss of nutritive value in the resulting hay.
 - (4) The temperature of the stack will give a very useful indication of the possibility of overheating, and will also help to indicate the necessity of taking precautionary measures. A temperature of 70°C. (158°F.) is the warning point, and a temperature of 90°C. (194°F.) marks the critical point; immediate precautionary measures are indicated when the stack heats to this extent. A temperature of 110°C. (230°F.) indicates the explosive point; opening the stack at this stage will probably lead to immediate firing.
 - (5) Inefficient methods of ventilation of the stack are worse than useless. The main aim in stack building and in preventing overheating should be consolidation not ventilation in cases where the hay is got in good condition.
-

A SCHEME of co-operative farming by small holders is in operation in a Midland county, and it is interesting to learn that the experiment so far has met with conspicuous success. The County Council purchased a farm in 1919 for the settlement of ex-Service men. Instead, however, of dividing the whole area into small holdings, the Council let one large holding jointly to four applicants. This holding comprises 182 acres of land, half of which is arable and half pasture, a farmhouse used as a residence by two of the partners, a cottage occupied by another partner, and outbuildings. A rent of £2 per acre is paid.

**Co-operative
Farming on
Small Holdings.**

The tenancy is held by the four partners, one of whom is accepted by the others as leader owing to his knowledge of agricultural work. Capital has been subscribed by each of the men, the leader having placed £1,000 in the fund. Each partner draws a weekly wage, and at the end of the working year part of the profits is divided between them pro rata to the share each has contributed; the balance is used as a reserve fund.

The holding is managed on strictly business lines. The work is distributed between the partners, two working as horsemen and one as stockman, while the leader assists in the milking, keeps the accounts and acts as general foreman. Hired labour is employed occasionally.

The live stock consists of 54 head of cattle, including 14 milch cows and a bull, 6 horses and several pigs of good type. There is also a flock of sheep, which at the end of November last was being folded on swedes. It was then proposed to winter 48 sheep and fatten 112 for sale.

About 20 gallons of milk were being sold wholesale daily in the town a few miles from the farm. This provided a weekly income of about £19, which the partners find very convenient for meeting current expenses. The stock and potato crops have realised good prices.

The success of this co-operative undertaking is due largely to the enterprise and industry of the small holders, to whom all credit is due for the thoroughness with which their work is done.

Among the Training Centres that have done much to improve not only the prospects but the health of ex-Service men, the one at Telscombe, near Newhaven, in Sussex, managed by the East Sussex Agricultural Committee for the Ministry, deserves mention. Work there is not yet a year old, but there are nearly ninety men receiving instruction—among them a certain number who suffered badly from shell-shock or lost limbs in the War. The work is varied. Poultry-keeping is the main source of the activities, trap-nesting and egg-recording being practised, but horticultural instruction is carried on extensively, while pigs and rabbits are also kept.

**Ex-Service Men
and Rural Life:
Training at
Telscombe.**

An experiment is being conducted at the Telscombe Centre to ascertain the relative values for table purposes of certain pure breeds and first cross. The varieties under test are:—*Pure Breeds*: White Wyandotte, Rhode Island Red, Light Sussex, and Brown Sussex; *First Crosses*: Coucou de Malines—Light Sussex, Indian Game—Light Sussex, Faverolles—Light Sussex, and Barred Plymouth Rock—Light Sussex.

The chickens reared from these breeding pens will be weighed at different stages, and their relative rates of growth noted. A test will also be made of the comparative commercial results obtainable from the various methods of fattening, i.e., cramming, trough feeding and open pen feeding.

The rabbits kept at Telscombe are those having pelts of special value. Blue Beverens and Havanas are the favourites, and some are kept in the runs with the chickens—a method that enables them to get more exercise than they could hope to obtain in a hutch.

The trainees live in army huts during the week, but some come from Brighton, only a few miles away, and go home from Saturday to Sunday night. The skill of one trainee who, having lost an arm yet contrives by means of special appliances to kill, pluck, dress and truss chickens in record time and literally single-handed, has already attracted widespread attention.

On the horticultural side the teaching deals with garden soils, draining, trenching, digging, ploughing, manuring, enclosing, the treatment of bush fruit and fruit trees, planting and transplanting, insect and fungoid pests, and the cultivation of all vegetables. Favourable weather is devoted to work on the land, and during the worst of the year, when the land is unapproachable, lectures are given, or manual work is done in the shops.

It should be noted that in furtherance of the policy of practical teaching and the preparation of the trainees for the actualities of life after leaving the Centre, many appliances used at the Centre are hand-made. The trainees make their own poultry houses and appliances of various description, and when they have completed appliances for which there is no immediate use at the Centre they find invariably that there is a ready market for them outside. The duration of the course of training is one year. It might be mentioned that the very thriving pigs kept at the Station are fed entirely on kitchen waste and small potatoes; and they are yielding first-class pork to the trainees at a cost that would make the average housewife very envious.

* * * * *

THE abnormal conditions of labour and marketing during the war have had unfortunate results upon many crops in this country, but it seems likely that none has suffered as great a measure of deterioration as the English field pea.

Field Rogueing of English Peas.

Prior to the War it enjoyed a greater reputation and commanded a higher price than any other variety. At the present time, however, the position is reversed; large quantities of Tasmanian, Japanese and Dutch peas are being imported and find a ready sale owing to their superior appearance, while the English stocks have become badly mixed, not only with purple-flowered varieties but with several types of green pea.

There is a three-fold reason for this deterioration. *Firstly*, the scarcity of labour for the land resulted in defective cultivation; *secondly*, the shortage of food-supply made it possible to find a ready market even for inferior qualities; and *thirdly*, the practice adopted by too many farmers of sowing their own home-saved, and degenerated stock for two or three seasons in succession.

The labour shortage has now lessened; purchasers are refusing to buy inferior goods at high prices, and there are still good supplies of properly "rogued" seed in the country. The remedy is in the hands of the farmer and contractor, and it is for them to say whether this branch of agriculture shall regain its old position of ascendancy, or be ultimately driven from the field by its foreign rivals.

Special knowledge and experience are necessary for seed-raising. The inexperienced grower would probably be best advised to grow on contract, and follow closely the instructions of the expert. The present position of the industry gives yet

another illustration of the truth that the use of home-saved seed is so frequently bad economy. It was noticeable in last season's crop, that a large percentage came out "round," neither green field peas such as the flat-sided semi-wrinkled "Harrison's Glory" nor indented Marrowfats, and that this was at its worst when the crop was from home-saved seed.

Two things must be done if the position is to be restored. *Firstly*, in the purchase of seed it will prove to be money well invested to sow the best quality procurable; *secondly*, the absolute necessity for field-roqueing must be realised, for if this is neglected, no degree of care and skill will avail to obtain the desired standard of improvement.

To facilitate proper cultivation and roqueing, peas should be grown in rows not less than 12 inches apart. In this way no permanent injury will be done to the crop in roqueing, and the value of the harvest will be greatly enhanced.

Purple-flowered hybrids can be eliminated easily by "roqueing"—so far at least as our present knowledge goes—and since the axils of these are so coloured that they catch the eye, the crop can be "rogued" for the first time as soon as the plants are about eight leaves high, and any that escape at this time can be "rogued" again on the blossom. If the farmer will take the trouble to have these precautions carried out, and where growing on contract gives free access to the expert "roguer," there seems no reason why English peas should not recapture their former position of pre-eminence within the course of the next two years.

Unfortunately many stocks contain numbers of white-flowering types differing in pod-shape, length of haulm, shape, size, colour of seed, &c.; in such cases field-roqueing becomes a matter of extreme difficulty. The only real remedy for establishing re-selected true stocks, is for the growers to pick out a few perfectly typical plants of the desired varieties, or better still, to raise and work up a stock from a single perfect plant.

THE importance of re-stocking eel ponds and rivers annually is probably insufficiently realised by the owners of such waters.

**The Ministry's
Scheme of Elver
(Eel Fry)
Distribution.**

It may not be generally known that the common or "freshwater" eel does not breed in the rivers and streams in which the greater part of its development takes place. Unlike the salmon, which returns from the ocean in the spring to breed in the river, the eel, when

ready to breed, travels in the autumn in the reverse direction, from river to ocean. Recent discoveries have shown that with the object of breeding the eel undertakes an immensely long journey, the probable breeding place of all the European eels being far out in the Atlantic. When about to depart, the eel changes its colour from yellow to silver, resembling in this respect, and in its large eyes, the fish that inhabit the ocean at a depth of from 50 to 300 fathoms. The breeding eels never return, but the larvæ are carried eastwards and north-eastwards by the North Atlantic drift, and after a long time, probably about two years, become elvers (eel fry). In the spring the elvers make their way to the fresh water, where, after feeding and growing for from 3 to 12 years they become mature "silver" eels.

It has long been known that eels descend to the sea in the autumn and that elvers ascend the rivers in the spring, but it had been assumed until comparatively recently that the elvers were the offspring of the eels which had descended the previous autumn. It was not until 1904 that any definite knowledge was gained of the breeding habits of the eel, and the exact breeding grounds have only just been discovered by the eminent Danish naturalist, Dr. Johannes Schmidt. Dr. Schmidt has proved that the European eel is not split up into local races, but that only one species exists, and this is found on the coasts and in the rivers of all countries that border the Eastern North Atlantic, from Iceland and Scandinavia to Morocco and Madeira and throughout the Mediterranean. It lives under a variety of conditions, in hot and cold climates, in the sea and in fresh water, in rivers, lakes, brooks and ponds.

The distribution of the larval eels from the Atlantic breeding ground is determined by the set of the prevalent marine currents. This explains why elvers are most abundant in countries that lie nearest to the Atlantic. Since the stock of each river is thus replenished from a common source, the limitation of the capture of silver eels in any one river is not likely permanently to affect the stock in that river. It follows that the effective method of keeping up or increasing the supply of eels in a healthy river is each season to transport elvers to the river from waters where they are more abundant.

In view of the discoveries with regard to the breeding habits of eels the German Fisheries Union established in pre-War days a depot at Epney-on-Severn for the supply of elvers to Germany, whence some of the grown eels were subsequently

re-imported into this country for consumption. During the War the Ministry took over this depot from the Public Trustee, and has since distributed elvers among suitable British waters by selling them at low fixed prices, with the object of encouraging the growth of eels for the market and thus increasing our home-grown food supply. The elvers may be taken from the Severn from the end of February onwards, and the earlier they are transported the better they are likely to stand the journey to other waters. Full particulars of the distribution may be obtained on application to the Fisheries Secretary, Ministry of Agriculture and Fisheries, 43, Parliament Street, London, S.W.1.

Orders will not be accepted after April 1st.

* * * * *

THE Ministry has revoked, as from the 1st December last, the Orders requiring the compulsory general dipping of sheep in

**Regulations as
to Dipping of
Sheep.**

this country involving a single dipping or (in Scotland and the North of England) two dippings at long intervals. The Ministry recognises, however, that Local Authorities and sheep owners in various parts of the country may wish to continue the general compulsory dipping of sheep in their districts as a safeguard against the risk of the introduction of the disease to their flocks, and powers have accordingly been given enabling them to do so. The Ministry desires, however, in this connection, to emphasise the fact that in the event of any Local Authority deciding to exercise these powers, nothing short of double dipping in a dip approved by the Minister, with an interval of not less than ten and not more than fourteen days between the dippings, would, in the considered opinion of the Ministry, serve the purpose in view.

It is desirable that the provisions of the Onion Smut Order of 1920, issued by the Ministry in May last in the interests of

**The Onion Smut
Order of 1920.**

controlling the spread of Onion Smut (*Urocystis cepulæ*) in this country should be known as widely as possible. Onions and leeks, whether seedlings and sets or bulbs, come within the scope of the Order. The main provisions of the Order are as follows:—

(1) *Restrictions as regards Infected Places.*—(a) No person shall sow or cause to be sown onion seed in an infected place,

or plant or cause to be planted any onion seedling plants in an infected place unless such plants have been raised in land which is not in an infected place.

(b) Onion plants grown in an infected place shall not be removed from the infected place unless and until the plants have been inspected while growing by an Inspector of the Ministry and certified by him to be free from Onion Smut, and have been washed free from soil.

(2) *Restrictions as regards Movement of Onion Plants grown in an Infected Area.*—No person shall remove outside an Infected Area any onion plant grown in the Infected Area unless and until the plant has been inspected while growing by an Inspector of the Ministry and certified by him to be free from Onion Smut.

(3) *Dealings with Diseased Plants.*—An Inspector of the Ministry may by notice served on the owner or person in charge of plants affected with Onion Smut require the destruction by him forthwith of such plants by fire or other suitable method, and the same shall thereupon be destroyed accordingly. Onion plants visibly affected with Onion Smut shall not be sold, or offered for sale for any purpose.

(4) *Notification of the Disease.*—(a) The occupier or other person in charge of any land in an Infected Area on which Onion Smut exists or appears to exist, and any person having in his possession or under his charge onions which are affected with Onion Smut, shall forthwith notify the fact by post or otherwise to the Ministry or an Inspector of the Ministry.

(b) If Onion Smut is found to exist in any subsequent year on land in respect of which notification of disease has been given a further notification of disease shall be given.

Failure to comply with the Order renders a person liable to penalty not exceeding £10. The Order does not apply to Scotland or Ireland.

A full text of the Order (No. 720 of 1920) may be obtained from H.M. Stationery Office, Imperial House, Kingsway, London, W.C.2, price 1d., excluding postage.

* * * * *

At this season of the year the disease known as "Dry Rot" is apt to show itself in regrettable quantity in seed of first early potatoes. It is particularly severe in the variety May Queen. The disease is caused by a fungus which, entering the seed after lifting, develops extensively after the turn of the

**Dry Rot of
Potatoes.**

year and destroys the set. It is now too late to check the fungus, though the further spread of the disease should be prevented by removing and burning affected specimens. As seed of early potatoes is a valuable commodity it may not be amiss to point out how the trouble may be reduced next season.

It has been shown that careless handling and bruising are very important factors in predisposing the tubers to disease by assisting the fungus to gain entrance. Early varieties for seed purposes should be lifted in good time, handled and riddled with great care, and put into the sprouting boxes as early as possible in the autumn. Tubers which are boxed in October and "greened" early are seldom badly attacked. Extremely susceptible varieties like Ninety Fold and May Queen should never be stored in clamps or in bins. It is perhaps advisable to state that Dry Rot is a disease quite distinct from the common blight, which is often responsible for loss of seed during winter. (For further information on Dry Rot see Leaflet No. 193, and for Potato Blight Leaflet No. 23.)

Foot-and-Mouth Disease.—*Kent (Wingham District), Shrewsbury, and Droitwich.* No further outbreaks having occurred in any of these districts, all restrictions imposed in connection with the outbreaks have been withdrawn.

Lincolnshire (Grimsby District).—Seven outbreaks in all have now been confirmed in the Grimsby district, the latest being on the 20th January. The district subject to restrictions has been considerably contracted, and now consists of the country lying within a radius of about five miles from Grimsby.

Lincolnshire (Ormsby District).—No outbreak has occurred in this district since that on 3rd January, and all general restrictions have now been withdrawn.

Midland Counties Group.—The position in the Midland Counties district has improved considerably, and general restrictions are now in force only in an area comprising the City of Birmingham and the parish of Sheldon, and three other small areas around the actual outbreaks. In the Birmingham district, 8 outbreaks in all occurred, the last on the 18th January; in the Stow-on-the-Wold district and Banbury districts no further developments have occurred since the issue of the February *Journal*.

Gloucestershire and Herefordshire District.—No outbreak has been confirmed in this district, since that already referred to on 12th January, and restrictions are now applicable only to one small area in the Ledbury district.

Yorkshire (East Riding).—Five outbreaks in all have been confirmed in the Halsham district, the most recent being on 11th February, at Hollym. The restrictions on movement have been considerably modified, and now apply only to an area of about five miles radius.

Rabies.—*Wiltshire, Dorset and Hampshire.*—Five fresh outbreaks have occurred in this district since the issue of the February *Journal*, four cases being confirmed at Southampton and one at Salisbury—the latter occurred on

the 8th February. The Scheduled District has now been extended so as to include the remainder of the County of Southampton, and this brings the Portsmouth district also within the Muzzling Area. An Inner Controlled Area has also been prescribed round Southampton in view of the number of cases confirmed in and near that town.

Glamorgan.—There has been no development in this district.

Berkshire.—On the 13th January last, a case of Rabies was confirmed in Basingstoke, which was within the existing Scheduled District, and also at High Wycombe, just outside the north-eastern boundary of that district. The former case did not involve an extension of the Berkshire scheduled district, but the latter rendered it necessary to add to the scheduled district an area lying within a radius of about fifteen miles of High Wycombe. A second case occurred at High Wycombe on the 22nd January, and one at Reading, in the inner area on the 4th February. The inner controlled area was reduced as from the 8th February to its original limits of 5 miles radius from Reading which were fixed on 30th September last.

London.—There have been no developments in the Metropolitan district, and all restrictions have been removed except from the inner controlled area (Acton district) and from a small portion of the borough of Woolwich, in respect of which restrictions on "movement out" have been maintained as a precautionary measure, owing to the report of a suspected case of rabies in that borough. This case necessitates inoculation experiments being made before a decision can be given. In the event of the decision being negative the restrictions in respect of this small area in Woolwich will be removed.

Trench System of Ensilage.—In the Article on "Pit, Trench and other Silos," by Mr. A. W. Oldershaw, which appeared in the February *Journal*, a statement is made that "It is not suggested that the method of making silage in pits or trenches results in material of the same high quality as that made in cylindrical tower silos, but there is no doubt that thoroughly good silage can easily be made in this way."

The writer of the Article wishes to state that he has since had an opportunity of making further investigations as to the quality of silage made according to Mr. Makens' Trench System. Some excellent samples of silage have been made this year by the above method, and Mr. Oldershaw is now quite convinced that if care is taken to make the silage exactly as described, keeping it well trampled down and afterwards carefully covered up with earth, the quality of trench silage is in no way inferior to the best samples made in cylindrical tower silos. Moreover, if the silage in the trench or pit is carefully topped up with useless material, &c., it would appear that the amount of waste on the top need not be materially greater than that which often occurs on the top of cylindrical silos. Two trench silos were constructed by Mr. Arthur Symonds, Shelland, Suffolk, during the past year—in both cases on quite heavy land. Drains were arranged to drain off the water, and it was found that there was no excessive amount of loss in the trench. It is worthy of note that, with a cylindrical tower silo, if the material is put in carelessly and without a sufficient amount of trampling round the outside, quite a considerable loss may take place owing to air gaining admission through the carelessness of those engaged in filling the silo.

The Examination of Diseased Bees.—The Ministry desires to inform bee-keepers that the examination of diseased bees is no longer conducted at the Department of Comparative Anatomy, The Museum, Oxford. Pending the appointment by the Ministry of a bacteriologist to undertake such work, Dr. J. Rennie has kindly consented to carry out examinations and to furnish reports to the bee-keepers concerned. In future, therefore, specimens, together with the name and address of the sender, should be sent to Dr. J. Rennie, Marischal College, University of Aberdeen.

Reduction in Price of Sulphate of Ammonia.—Owing to a decline in the world prices of nitrogenous Fertilisers, the makers have agreed to reduce the price of Sulphate of Ammonia for the remainder of the 1920-21 Season. The net cash prices for Sulphate of Ammonia delivered to consumer's nearest railway station or wharf in Great Britain, or in the case of deliveries to Ireland, the Channel Islands or the Isle of Man, f.o.b. British port, in quantities of not less than 4 tons, will be :—

January	1921	...	...	...	£23	16s.	0d.	per ton.
February	"	...	...	...	£24	3s.	6d.	"
March—May	"	...	...	...	£24	11s.	0d.	"

The conditions of sale and scales of allowances and additional charges given in leaflet F.P.506/S.I. will remain in force, except that the trade discount to Fertiliser Mixers, Agricultural Merchants and Co-operative Societies will be increased. All orders already placed for January/May delivery will be executed at the above prices, and the increased discount will be paid on them.

As a number of Farmers, Fertiliser Mixers, Merchants and Co-operative Societies were encouraged to take early deliveries of Sulphate of Ammonia by the difference between the maximum prices for the earlier and later months of the season, as originally announced, the British Sulphate of Ammonia Federation, Ltd., has refunded certain sums on orders placed with it or with its consent for Sulphate of Ammonia delivered and paid for at the August/December prices; consequently farmers who purchased from merchants at the prices ruling in these months should apply to their merchants for a corresponding allowance to be made to them.

Notice to Stallion Owners: Licences under the Horse Breeding Act, 1918.—Owners of stallions who intend to travel their stallions during the 1921 season are reminded again that they will require Licences from the Ministry to enable them to do so, and that as the Ministry cannot undertake to issue licences at very short notice, owners of stallions who postpone the necessary application may experience considerable delay in obtaining them.

Licences which were issued for the 1920 season expired on the 31st October last, and any licence for that season not already returned should be forwarded to the Ministry forthwith. Failure to return any expired licence renders an owner liable to a fine of £5.

A Map of Wart Disease Infected Areas.—The Ministry has issued a map showing those districts in England and Wales which are now Infected Areas under the Wart Disease of Potatoes Order of 1919. This map should prove of value to all persons concerned in the distribution and movement of "seed" potatoes. A licence must be obtained from the Ministry before any "seed" potatoes, other than certified stocks of varieties approved by the Ministry as immune to Wart Disease, are introduced into these Infected Areas.

Copies of the map, together with a list of the Infected Areas, may be obtained on application to the Ministry at 10, Whitehall Place, London, S.W.1. Price 6d., post free.

Horticultural Inspection for Export: New Scale of Charges.

The Ministry desires to inform nurserymen and others interested in the export of plants or potatoes to Foreign Countries and Colonies that it has been found necessary to revise the existing scale of fees charged, whether for the work of inspection or for the issue of certificates. The revised scale will come into operation on the 1st March, 1921, except in cases where an inclusive fee has already been paid to cover the issue of certificates down to the 31st May next. The new fees will be as follows:—

For inspection of nurseries £2 2s. per day with minimum of £2 2s.

For inspection of growing crops of potatoes (for export to Holland or elsewhere). Minimum of £1 1s. but fee will vary with acreage inspected.

For each certificate issued 1s.

The scale of fees for the inspection of small consignments of plants at the Ministry's Offices, including the issue of certificates, will remain as before, viz. :—

Packages not exceeding 11 lb. in weight 1s. 0d. each.

„ over 11 lb. but under 56 lb. in weight 2s. 6d. „

„ „ 56 „ „ „ 1 cwt. „ 5s. 0d. „

Leaflets issued by the Ministry.—Since the date of the list given on page 1084 of last month's issue of this Journal the information contained in the following leaflets has been revised and brought up to date :—

No. 26.—Farmers and Income Tax.

„ 31.—The Onion Fly.

„ 56.—Apple Canker.

„ 62.—The Pear and Cherry Sawfly

„ 120.—Peach Leaf-Curl.

„ 126.—The Sheep Maggot Fly.

„ 235.—Organisation of the Milk Supply.

„ 239.—The Pear Leaf Blister Mite.

The following leaflets of the Ministry have been transferred to the Forestry Commission, 22, Grosvenor Gardens, London, S.W.1:—

No. 91.—The Pine Beetle.

„ 99.—Relationship of Woods to Domestic Water Supplies.

„ 103.—The Pine Sawfly.

„ 138.—Pine Weevils.

„ 140.—The Felted Beech Coccus.

„ 155.—Larch Canker.

„ 183.—Sycamore Leaf Blotch.

„ 186.—The Large Larch Sawfly.

„ 199.—The Pine Disease.

„ 208.—Larch Shoot Moths.

NOTICES OF BOOKS.

Forest Products—Their Manufacture and Use.—(Nelson Courtland Brown. London: Messrs. Chapman & Hall. Price 21s.). This book deals with the commercial aspect of the manufacture and use, in the United States of America, of all important forest products with the exception of lumber, and is intended as a brief treatise, preliminary to a more exhaustive work or group of books to be written at a future date. It is the work of one whose connection with the American Timber Trade Commission and Department of Commerce should render him well qualified to deal with his subject, and who has spared no pains to ensure the accuracy of his statements by obtaining the views of specialists in those branches of industry with which he deals. In consequence of the difference between conditions obtaining in the United States of America and those met with in Great Britain, both as to market requirements, labour, and the supply of raw material, it is but natural that this interesting book, written by an American, and dealing with North American conditions, should have little direct bearing upon such problems in the disposal of home-grown timber as arise in the British Isles. The volume will appeal, therefore, rather to the general reader than to the serious student of British forestry, who will be interested in it mainly in so far as it suggests future possibilities in the development of forest industries in these islands, and weighty considerations bearing upon the formulation of forest plans.

The opening chapter of the book comprises a brief resumé of the American situation as regards the consumption and supply of timber, and in calling particular attention to the wastage consequent upon the ordinary methods of lumbering serves to emphasize the importance of the conservation of timber resources, and the elimination of that waste in manufacture which is shown in the subsequent chapters of the book to be at almost all times considerable, and which, in view of the present decreasing reserves of available timber, deserves serious consideration.

The plan adopted by the author has been to allot one chapter of the book to each forest product and therein give a brief historical statement followed by a concise and remarkably complete summary of the methods adopted in its handling, manufacture and disposal, together with, in most cases, specifications of both raw material and finished product, and important and interesting statistical information, conveniently arranged in tabular form, as to the importance of the commodity, the prices both of finished product and raw material, costs and efficiency in manufacture, and a statement of the labour employed per unit of production. The latter statement, in particular, should be of value for purposes of comparison with results obtained in similar operations in this country. The amount of technical detail given in the description of the manufacture and handling of each product should suffice in all cases to give the reader a true appreciation of the main mechanical and financial considerations involved.

The chapters having the most useful information bearing upon present conditions in the British Isles, as regards utilization of existing timber and scrub-wood, or preparations for future crops are, perhaps, those on the Pulp and Paper Industry, Wood Distillation, Fuel Wood, and Slack and Tight Cooperage, whilst the remarks on the Tanning and Charcoal-Burning Industries

in America are of particular interest in view of the problems connected therewith in this country.

The book is admirably arranged and profusely illustrated with photographs, and is provided with an excellent and very complete index. The inclusion of a table of the scientific and common names for timbers dealt with, and the use in the text of the scientific names wherever confusion might arise, is a practice worthy of more frequent adoption in such works.—O. J. S.

Forest Management.—(A. S. Recknagel and John Bentley, Jr. London: Chapman & Hall Limited. First Edition 1919, Price 12s. 6d. net.) This book purports to provide the American reader with a condensed and not too technical account of the subjects comprised under the head of Forest Management.

The subject matter is treated under the following main heads:—

Forest Mensuration.

Forest Organisation (including Working Plans).

Forest Finance.

Forest Administration.

One hundred and twenty-two pages, or rather more than half the book, deal with the subject of Forest Mensuration. Forest Organisation occupies fifty-five pages, the remaining sections being more briefly dealt with.

The long section on Forest Mensuration covers much the same ground as the corresponding chapters in Vol. III of Schlich's Manual of Forestry, but in the American work much of the space is devoted to such subjects as area surveys, log rules, and timber estimations on a large scale, which are of no importance to most students in this country.

Chapters X and XI give a short but useful account of methods of determining the increment of single trees and woods. We are bound to point out, however, that on page 116 the determination of the volume of permanent sample plots by the arithmetical mean sample tree method is open to criticism on the ground that other and more accurate methods (*e.g.*, those of Hartig and Urich) have long been employed by the Research Stations in Europe.

The important subject of Working Plans is somewhat cursorily dealt with in Chapter XIV, but the outline provided gives an excellent idea of the information required for these plans.

British students will find Chapter XV on Forest Finance most useful as an introduction to a subject which is often found troublesome. In particular, the U.S.A. Government's detailed instructions for calculating fire damages (on pages 201 to 208) provide interesting illustrations of the practical value of compound interest formulæ in general forestry. The final chapter deals briefly with the subject of Administration. We fancy that most British foresters will be surprised by the statement on page 217 that "while the average executive unit in Europe is 6,000 acres, the average unit in the United States National Forests is no less than 1,022,200 acres." Any except the most extensive system of working must be out of the question with units of this size.

The book is well printed and provided with an Appendix containing the usual compound interest tables and other data; there is also an excellent index.

The book may be recommended to students in this country who wish to obtain a general survey of the subject of Forest Management before taking the more advanced courses given at the Universities.—W. H. G.

ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous.

- Wood, T. B.*—The Chemistry of Crop Production (193 pp.). London : University Tutorial Press, 1920, 5s. 6d. [64(02).]
- Okey, Thomas.*—The Art of Basket-Making (158 pp.) London : Pitman & Sons, 4s. [63.103.]
- Thring, Douglas T.*—Mole-Draining and the Renovation of Old Pipe Drains (13 pp.). London : John Murray, 1920, 6d. [63.14.]
- Leeds University and Yorkshire Council for Agricultural Education.*—No. 115 :—The Need for Lime on Ploughed-out Grass Land, *J. A. Hanly* (14 pp., + 8 illus.). Leeds, 1920, 6d. [63.15.]
- Michigan Agricultural Experiment Station.*—Tech. Bull. 45 :—The Effect of Fertilizer Salts Treatment on the Composition of Soil Extracts (18 pp) East Lansing, 1919. [63.113; 63.16.]
- New Jersey Agricultural Experiment Station.*—Circular 54 :—Improving Acid Soils (11 pp.). New Brunswick, 1916. [63.15.]
- Purdue Agricultural Experiment Station.*—Bull. 187, Vol. xviii. :—Acid Phosphate v. Raw Rock Phosphate as Fertilizer (27 pp.). La Fayette, 1916. [63.1672.]
- Geological Survey Memoirs.*—Summary of Progress of the Geological Survey of Great Britain and Museum of Practical Geology, 1919 (70 pp.). London : H.M. Stationery Office, 1920, 2s. 6d. net. [55 : 912.]
- New York Agricultural Experiment Station.*—Bull. 466 :—Spraying Lawns with Iron Sulphate to eradicate Dandelions. (59 pp.). Geneva, N.Y., 1919. [63.259(04).]
- Wisconsin Agricultural Experiment Station.*—Bull. 309 :—Marsh Soils. (32 pp.). 1919. [63.142.]
- Robertson, G. S.*—A Comparison of the Effect of various types of Open Hearth Basic Slags on Grass Land. (11 pp.). (Reprint from Transactions of the Faraday Society, vol. xvi, 1920) [63.1672; 63.33-16.]
- U.S. Department of Agriculture.*—Farmers' Bull. 1093 :—Influence of the Tractor on the use of Horses. (26 pp.). Washington, 1920. [63.175.]
- Kersey, H. W.*—Farm Book-Keeping : A Simple Method. (3rd Ed.), (96 pp.). Ashford, Kent, and London : Headley Bros., 1920, 3s. 6d. [657.]

[This book is designed to meet the needs of farmers and others who require a simple system of accounts demanding a minimum expenditure of time and trouble. It is also adapted for use in agricultural and horticultural colleges and schools. Single Entry and a simplified method of Double Entry are clearly explained by the aid of a number of worked examples, while a useful appendix is devoted to the subject of farmers' Income Tax.]

- Ritchie, J.*—The Influence of Man on Animal Life in Scotland : A Study in Faunal Evolution (550 pp.). Cambridge : University Press, 1920, 28s. net. [575.4; 59 (02).]

Field Crops.

- U.S. Department of Agriculture.*—Farmers' Bull. 1119 :—Fall-Sown Oats (21 pp.). Washington, 1920. [63.314.]
- U.S. Department of Agriculture.*—Bull. 883 :—Experiments with Flax on Breaking (29 pp.). Washington, 1920. [63.34111.]
- Nebraska Agricultural Experiment Station.*—Research Bull. 13 :—Studies concerning the Elimination of Experimental Error in Comparative Crop Tests (95 pp.). Lincoln, 1918. [63.31.]
- U.S. Department of Agriculture.*—Bull. 873 :—The Shrinkage of Market Hay (33 pp.). Washington, 1920. [63.1982.]
- Leeds University and Yorkshire Council for Agricultural Education.*—No. 114 :—Use of Implements in the Lifting of the Potato Crop (28 pp.). Leeds, 1920. [63.17(04); 63.512(04).]

Horticulture.

- New Jersey Agricultural Experiment Station.*—Circular 57 :—Asparagus (4 pp.). New Brunswick, 1916. [63.511.]
- U.S. Department of Agriculture.*—Bull. 859 :—The Process of Ripening in the Tomato, considered especially from the Commercial Standpoint (28 pp.). Washington, 1920. [63.513.]

Plant Diseases.

U.S. Department of Agriculture.—Bull. 842 :—The Nematode Disease of Wheat caused by *Tylenchus Tritici* (40 pp.). Washington, 1920. [63.27-31.]

U.S. Department of Agriculture.—Bull. 893 :—Experiments on the Toxic Action of Certain Gases on Insects, Seeds and Fungi (16 pp.). Washington, 1920. [63.2945.]

South Carolina Agricultural Experiment Station.—Bull. 204 :—The Slender Wireworm : Its Relation to Soils (14 pp.). Clemson College, S.C., 1920. [63.27.]

U.S. Department of Agriculture.—Farmers' Bull. 1128 :—Control of Aphids Injurious to Orchard Fruits, Currant, Gooseberry and Grape (48 pp.). Washington, 1920. [63.27-41.]

U.S. Department of Agriculture.—Bull. 866 :—Pickering Sprays (47 pp.). Washington, 1920. [63.295.]

Ohio Agricultural Experiment Station.—Bull. 333 :—Apple Blotch : A serious Fruit Disease (14 pp.). Wooster, Ohio, 1919. [63.24-41.]

New Jersey Agricultural Experiment Station.—Bull. 324 :—The Strawberry Weevil (19 pp.). New Brunswick, 1918. [63.27-41.]

Live Stock.

New South Wales Department of Agriculture.—Farmers' Bull. 132 :—Sheep and Wool for Farmers, Part II. Cross-Breeding for Wool and Mutton (61 pp.). Sydney, 1920. [63.63.]

Nebraska Agricultural Experiment Station.—Bull. 170 :—Fall Lamb Feeding (28 pp.). Lincoln, 1918. [63.63.]

Wisconsin Agricultural Experimental Station.—Bull. 313 :—The Occurrence of Red Calves in Black Breeds of Cattle (35 pp.). Madison, 1920. [675.1.]

Veterinary Science.

U.S. Department of Agriculture.—Farmers' Bull. 1146 :—Dourine of Horses (12 pp.). Washington, 1920. [619 1(b).]

Purdue Agricultural Experiment Station.—Circular 56 :—Methods of Vaccination, Control and Eradication of Hog-Cholera (20 pp.). Lafayette, 1916. [619 4(a).]

Texas Agricultural Experiment Station.—Bull. 262 :—The Searing Iron or The Knife for Docking or Detailing Lambs (12 pp.). Texas, 1920. [63.63.]

Dairying and Food, General.

Tanner, F. W.—Bacteriology and Mycology of Foods (592 pp.). New York : Wiley & Sons, 1919 [576.8; 612.39.]

Canada, Department of Trade and Commerce.—Commercial Series No. 1.—The Dairy Industry of Canada (11 pp.). Ottawa, 1920, 5 cents. [63.7(71).]

Michigan Agricultural Experiment Station.—Special Bull. 99 :—The Detroit Commission Plan of City Milk Administration (30 pp.). East Lansing, 1919. [63.714.]

Purdue Agricultural Experiment Station.—Bull. 189, Vol. xix :—Cream Testing Balances (20 pp.). La Fayette, 1916. [63.712.]

Birds, Poultry and Bees.

Purdue Agricultural Experiment Station.—Bull. 182, Vol. xviii :—Poultry Investigations : I. The Value of Meat Scrap, Fish Scrap, and Skim Milk in Rations for Laying Poultry (4 pp.). La Fayette, 1915. [63.6515.]

U.S. Department of Agriculture.—Farmers' Bull. 1108 :—Care of Baby Chicks (8 pp.). Washington, 1920. [63.651(04).]

U.S. Department of Agriculture.—Farmers' Bull. 1113 :—Poultry Houses (8 pp.). Washington, 1920. [63.6 : 695.]

U.S. Department of Agriculture.—Bull. 1102 :—The Crow in its relation to Agriculture (20 pp.). Washington, 1920. [59.162.]

Engineering.

Federazione Italiana dei Consorzi Agrari.—I Silos per Foraggi : Tipo Cremasco (16 pp., + 11 illus.). Piacenza : Biblioteca Popolare Agraria, 1920. [694.]

U.S. Department of Agriculture.—Bull. 854 :—The Flow of Water in Drain Tile (50 pp.). Washington, 1920. [63.14(04).]

Economics.

- National Council of Social Service.*—Public Services, 2nd Edit. (96 pp.). London: P. S. King & Son, 1920, 2s. net. [35.]
- U.S. Department of Agriculture.*—Farmers' Bull. 1144 :—Co-operative Marketing (27 pp.). Washington, 1920. [394.6.]
- U.S. Department of Agriculture.*—Bull. 860 :—The Organization of Co-operative Grain Elevator Companies (40 pp.). Washington, 1920. [394(04).]
- Ontario Department of Agriculture.*—Bull. 279 :—Community Halls (12 pp.), 1920. [36.]

SELECTED CONTENTS OF PERIODICALS.

Agriculture, General and Miscellaneous.

- Agricultural Climatology of Australia*, Dr. G. Taylor. (Jour. of R. Met. Soc., Vol. xlv., No. 196.) [551.5.]
- Les Plantes Marines*, P. Gloess. (Chimie et Industrie, Vol. 3, No. 3, 1920.) [58.2.]
- The Influence of Cold in Stimulating the Growth of Plants, F. V. Colville. (Jour. Agric. Res., Vol. xx., No. 2.) [58.11.]
- Influence of Moisture on Soil Bacteria, J. E. Greaves and E. G. Carter. (Soil Science, Vol. x, No. 5, Nov., 1920.) [63.115.]
- Aluminium as a Factor in Soil Acidity, J. J. Mivasol. (Soil Science, Vol. x., No. 3, Sept., 1920.) [63.113.]
- Forsøg med Kogsalt og Kalisalte, H. R. Christensen. (Tidskrift for Planteavl, Bind 26, Hæfte 5, 1920.) [63.167.]

Field Crops.

- A Comparative Study of Corn Silage in Concrete and Stave Silos, R. H. Shaw and R. P. Norton. (Jour. of Dairy Sci., Vol. 3, No. 4) [63.1985.]
- Line Selection Work with Potatoes, O. B. Whipple. (Jour. of Agric. Res., Vol. xix., No. 10.) [63.512.]

Horticulture.

- Investigations in the Ripening and Storing of Bartlett Pears, J. R. Magness. (Jour. Agric. Res., Vol. xix., No. 10.) [63.41(a).]

Live Stock.

- The Efficiency of Milk Substitutes in Calf Feeding, G. Spitzer and R. H. Carr. (Jour. of Dairy Sci., Vol. 3, No. 5.) [612.394.]

Dairying and Food, General.

- Arable Dairy Farming, J. C. Brown. (Jour. Farmers' Club, Part 7, Dec., 1920.) [63.70(04).]

Engineering.

- The Problem of Adhesion of Agricultural Tractors, C. Julien. (Int. Rev. of Sci. and Practice of Agric., Year x., Nos. 7-8-9.) [63.17.]

INDEX TO VOL. XXVII.

APRIL, 1920, TO MARCH, 1921.

NOTE.—References to *Insects*, &c., and *Fungi* are indexed under the headings "*Insects*, &c." and "*Fungi*" only, to *Weeds* under the heading "*Weeds*" only, to *Fruit* under the heading "*Fruit*" only, and to *Diseases of Animals* under "*Diseases of Animals*" only.

Articles or reports on the following subjects have appeared in the *Journal* each month or from time to time, and are not separately indexed.—Notes on Feeding Stuffs, Notes on Manures, Notes on Crop Prospects and Live Stock Abroad, Notes on Agriculture Abroad, Notes on the Weather, Notes on Agricultural Labour in England and Wales, Notes on Agricultural Conditions in England and Wales, Prices of Agricultural Produce, Outbreaks under the Diseases of Animals Acts, Lists of Additions to the Ministry's Library, and Selected Contents of Periodicals.

Editorial Notes are indexed under the subjects to which they refer.

To avoid confusion in reference the term "Ministry" is used throughout, with a very few necessary exceptions, although the word "Board" may appear in the text.

	PAGE
Accounts, see <i>Book-keeping</i> .	
Adams, Lionel E. . The Life History of the Common Mole ...	659
Agricultural Council for England :	
First meeting	893
Minister's address	912
Agricultural Executive Committees :	
County Committees; Formation of	186,790
Cultivation of land	693
Report on farms taken over by	296
Village Clubs; Housing of	148
Work of, since the Armistice	437
Agricultural Research, see <i>Research</i> .	
Shows, see <i>Exhibitions and Shows</i> .	
Agricultural Returns and Statistics .	
Acreage and live stock returns, England and Wales ...	200,587,993
Decrease in number of sheep kept	129
Hops, acreage, 1918-1920	589
Poultry and eggs	17
Produce and yield of potato and root crops, 1920 ...	1077
of crops, England and Wales	888
Air, pollution by coal smoke	69
Nitrogen from the	417
Allotments, see <i>Small Holdings and Allotments</i> .	
Ammonium nitrate, see <i>Manures</i> .	
Amos, Arthur : The Harvesting of Mangolds	559
Anderson, Miss D. : Moorland Grazing	928
Animals, see <i>Livestock</i> .	
Antwerp : Horticulture and International Friendship : Exhibit	389
Apples, see <i>Fruit</i> .	
Austria, wart disease of potatoes in	1076
Ayrton, Maxwell : Cottage restoration and adaptation ...	730
Bacteria and Bacteriology .	
Bacterial blight of barley and oats	210
Effect of acidity on soil bacteria	78
<i>Bacillus atrocephalus</i>	79
<i>mesentericus</i>	78
<i>mycoides</i>	78
<i>subtilis</i>	78
<i>Xanthochlorum</i>	79
Barber, Prof. A. F. : Hand loom weaving	561

	Page
Barley :	
Bacterial blight	210
Field trials at Aberdeen and Rothamsted	47
Barratt, Kate . Women in horticulture	1137
Basic slag, see <i>Manures</i> .	
Bavaria : Society for the improvement of grassland... ..	88
Bayne, Bertha M. . A woman's impressions of a Danish small holding	52
Bees :	
Bee Disease Bull	1087
Disease, examination of suspected	639
Diseased, Ministry's arrangements	1174
Great Eastern Railway demonstration train	205
Restocking scheme	701
Sugar for bees	98
Belgium, wart disease of potatoes in	1076
Bensusan, S. L. :	
Farming on breck-land in Norfolk	123
Nation's fruit and vegetables	554
Rural economy at Oxford	272
Bewley, W F "Damping off" of tomato seedlings	670
Birds .	
The lapwing, protection of	315
The rook; its relation to farmer, fruit grower and forester	865
The starling	1115
Boodle, L A . Scorching of foliage by sea winds	479
Book-keeping (see also <i>Cost of Production</i>)	
Accounts of a Hampshire flock in 1918-1919	126
Advantages of	163
Arbitrary period for making up accounts	164
Cost basis of valuation	166
Farm accounts, profits and costs	162, 608
Income tax assessments	164, 167
" " effects of redemption of tithe rent charge	886
Keeping farm accounts	1161
Market basis of valuation	167
Method of book-keeping for farmers	163
Profit and loss sharing in agriculture	254
Reserves, estimation of	168
Valuation of ewes	126
" " rams	127
" " live and dead stock	165
Bracken, eradication of	111
Breck-land in Norfolk, farming of	122
British Dairy Farmers' Association	640
Brown, Edward Economic position of the poultry industry... ..	458
" J C The use of soiling crops in general farming	725
Butter, see <i>Dairying</i>	
Calcium cyanamide, see <i>Manures</i>.	
Camelford Co-operative and Dairy Society	16
Canada :	
Agricultural education	182
Importation of Canadian store cattle	704
Carr, R. H. :	
Progress of agricultural co operation in England and Wales since the Armistice	428
Carrots, yield on breck-land	123
Cereals, see <i>Corn</i>.	
Cheese, see <i>Dairying</i>.	
Cinema, as an aid to agriculture	778
Close, Thompson : Notes on the Lincoln tractor trials, 1920	714
Clover Wild white, value of, for pastures	60, 101
Coal Air pollution by coal smoke	69
Collinge, W. E. :	
The Rook; its relation to the farmer, fruit grower and forester	866
The starling	1115
Commissions and Committees :	
Adult education	146, 152
Agricultural	186, 198

Commissions and Committees—continued.	PAGE
Agricultural advisory	894
Agricultural machinery	2,91,187
Agricultural relief of the Allies	261
County Distributing (Forage) Committee	187
Herefordshire Agricultural Education Sub Committee	187
Ministry of Transport Committee	116
Royal Society Committee	133
Rural Department of the Council of Social Service	150
Scottish Committee for Belgian relief... ..	253
Small Holdings Committee	111
Taxation and regulations of road vehicles	115
Tropical Agriculture College Committee	189
Wholesale Food Markets of London Committee... ..	188
Wool and Leather Industries Commission in China	990
War Emergency Committee of the R.A.S.E.	250
Co-operation and Credit :	
Basket making, co-operation in	63
Burning of lime	161
Cainelford Co-operative and Dairy Society	16
Cheese making	103
Co-operative farming on small holdings	1165
Denmark :	
Co-operation in	56,174,188
Co-operative dairy in	55,175
" bacon factory in	55,175
" egg collecting depot in	55,175
France :	
Agricultural credit in Alsace-Lorraine	183
Pig insurance clubs	17
Progress in England and Wales since the Armistice	428
Village clubs association	147
Corn :	
History of a ' grain of wheat from seed bed to breakfast table '	624
Home grown prices of wheat : National Farmers' Union	895
Importance of sowing clean seed	718
Prices for British wheat	693
Protection of wheat against fungus pests	548
Sale of cereal seed	686
Trials of new varieties of winter wheat, 1919	694
Wheat and oat prices	394,396
" cultivation	597
" sowing	504
Winter oats—cultivation of	599
Cornwall :	
Cultivation of a moor in	9
Milk production in	14
Cost of production (see also <i>Book-keeping</i>) :	
Agricultural machinery—influence on	3
Butter	11,12
Farm costs :	
Advantages of	171
Definition of	169
Method of estimation	170
Food units, cost of	82
Milk, average price of production	18
" cost of winter production	983
Pig feeding and cost of pork production	340
Sheep, cost of keeping during summer months	127
" ewe and lamb per annum	128
Wheat growing	369
Cottages, see <i>Housing</i> .	
Cowie, G. A. : Nitrate of lime, its manufacture and use	43
Crops (see also <i>Corn</i> and under specific headings) :	
Crop prospects in April	98
Cultivation of Land :	
*Acres under plough in 1872 compared with that in 1914	184
Agriculture Bill and ..,	198

Cultivation of Land— <i>continued</i> .		PAGE
Cropping at Harper Adams' Agricultural College	...	100
Cultivation of a moor in Cornwall	...	9
Cultivation Orders—enforcement of	...	437
Demonstration farm in Norfolk		
Marsh land	...	
Mole draining	...	977
Tillage	...	
Winter wheat: ploughing up of		
Work of County Executive Committees	...	6
Dairying.		
Arable dairy farming	...	99
Butter production, cost of	...	11
Butter: percentage of fat in	...	12
Cheese making, instruction in	...	103
„ pink discolouration	...	520
Education in industry	...	643
Milk:		
And mineral matter	...	392
Average price of production	...	13
Cost per gallon	...	11
Demonstrations in clean production	...	14
Electro-pure process of treating	...	15
Hoyberg process of testing fat content	...	779
Milking machines	...	506
Milking trials	...	643
Percentage of fat per gallon	...	12
Peroxidase in	...	16
Precipitation of albumen in	...	16
Production and co-operative cheese schools	...	14
Production of Grade "A"	...	15,640
„ breeding of dairy cattle for	...	647
Quantity for cheese making	...	10
Recording in England and Wales	...	842
„ societies	...	525
Reductase in	...	16
Whey and dairy by-products	...	13
Winter milk, cost of production	...	983
Yield in Denmark	...	55
Dallinger, P. G.: Women's institutes and agricultural education	...	940
Denmark:		
Acreage of	...	53
Co-operation in	...	56,174,188
Co-operative bacon factory	...	55,175
Co-operative dairy in	...	55,175
Co-operative egg collecting depot	...	55,175
Cropping on small holding	...	54
Danish Heath Society	...	85
Education in	...	175
Egg prices in	...	55
Exports of agricultural produce from	...	1073
Forage crops of	...	364
Forestry in	...	86
Housing on small holdings	...	174
Impressions of a visit to	...	172
Livestock on Danish small holding	...	54
Marsh land—drainage and cultivation of		
Marl	...	
Policy towards people settling on the land	...	52
Population of	...	52
Reclaiming heath land in	...	85
Rural conditions in: comparison with Wales	...	172
Rural education in	...	86
Small holding in—A woman's impressions	...	52
Small holdings—land of	...	172
Success of Danish agriculture—reasons for	...	173
Wart disease of potatoes in	...	1074
Women and small holdings	...	53
Yield of milk	...	55

INDEX

vii

	Page
Development Commission : Tenth report	1088
Diseases of animals and veterinary science :	
Abortion—prevention of	180
Anthrax	808
Anthrax, danger from shoddy... ..	21
Cattle plague—precautions against	689
Diseases of animals during 1919	806
Foot-and-mouth disease 92, 187, 192, 299, 318, 420, 528, 623, 786, 806, 892, 986, 989, 1080, 1172	1172
" " " " introduction from abroad	1004
" " " " the Ministry's policy	1086
Glanders	807
Parasitic mange	809
Rabies 89, 93, 192, 299, 497, 691, 786, 806, 892, 985, 990, 1081, 1172	1172
Research work	644
Sheep dipping regulations	1170
Sheep scab	808
Swine fever	807
Tuberculosis	89
Dorset Art and Crafts Association, The	769
Drainage :	
Case road grader	10
Denmark :	
Heath land reclaiming in	85
Marshland in	8
Orders	8,764
Ouse	791
Reclamation by agricultural means	109
River Lugg	218
Wainfleet	see
Education, see also <i>Research</i> (for training of ex-Service men see <i>Land Settlement of ex-Service Men</i>) :	
Agricultural machinery, proposed scheme for instruction in ...	2,108
" research scholarships	984
Canada, education in	182
Cheesemaking, instruction in	108
Clean milk production, Demonstrations in	14
Committee on Adult Education	146, 152
Co-operative cheese schools and milk production	14
Dairy industry	643
Demonstration of fruit trees by Ministry	83
" farm in Norfolk	8
Denmark, education in	86, 175
Educational officers, appointment of	156
Fruit preserving at Campden	216
Great Eastern Railway demonstration train	205
Herefordshire Sub-Committee	157
Ministry's model allotment	82
National Diploma in Agriculture	195
Poultry keeping, education in	753
Poultry scheme of Ministry	100
Rat Research Institute	109
Research Institute	600
School for Women's Institute Organisers	199
Shows, value of	181
United States : " Farmers' Week in Missouri "	202
Farm Power Conference at Chicago	64
Village industries	152, 153, 154, 155
Institutes	175, 209
Wales	207, 358, 940
Women's Institutes	
Eggs, see <i>Poultry</i> .	
Electricity :	
Experiments	76
Treatment of seeds for increased yields (Wolfryn process) ...	495
Elvers : Ministry's scheme of eel fry distribution	1168

Ensilage, see <i>Silage</i> .	Page
Entomology, see <i>Insects</i> .	
Ernle, Rt. Hon. Lord :	
Agriculture during two great wars 1793-1815 and 1914-18	227
The enclosure of open-field farms	831, 891
Errata, see under <i>Journal of the Ministry of Agriculture</i> .	
Exhibitions and Shows :	
British horticulture exhibit at Antwerp	389
Home handicraft exhibits	314
Ideal Homes Exhibition	81
International Dairy Exhibition at Buenos Aires	593
International Livestock Exhibition in the Argentine	1072
London Thoroughbred Stallion Show, 1921	815
Royal Agricultural Show, Ministry's pavilion	304
Ex-Service men, see <i>Labour and Land Settlement for ex-Service men</i>	
Farm power problems	202
Farming :	
A modern Hertfordshire farm	921
Economics of small farming	782
The new farming landowner	1099
Feeding and Feeding Stuffs (see also Notes on Feeding Stuffs published periodically in this <i>Journal</i> and not separately indexed as such).	
Blood, dried, experiments with	266
Bulls, feeding of	178
Clover, value of wild white for pastures	60, 101
Common feeding stuffs, composition of	33
Comparison of feeding value of soiling crops and cakes	100
Cotton cake	118
County distributing (forage) committee	187
Dairy cows	118, 119
Feeding stuffs, imports and exports of	34
Fermenting chaff, method of	92
Fish meal as food for livestock	414
Food units, cost of	32
Forage : railway rates	100
Hay, see <i>Hay</i> .	
Horses, feeding of	120
Lactalbumen from whey	14
Lactose from whey	14
Linseed, composition of	27, 28, 29
Linseed chaff, composition of	30, 31
Lucerne seed, restricted importation of	499
Maize as a poultry food	225
Mango'ds. harvesting of	559
Oats as a poultry food	225
" for green food	99
Oat and wheat chaff, composition of, before and after fermentation	31
Oil cake from France	498
Palm kernel nut	118
Pig feeding and cost of pork production	340
Pigs, feeding of	121, 686
Poultry on pasture land	18
" feeding during egg laying competition	20
" food per diem while laying	226
" for chickens	226
Sheep, feeding of	120
Silage; composition and feeding value	67, 68, 277
Substitutes for oats as horse feed	120
" " hay	515
Sugar for bees	98
Wheat as a poultry food	224
Whey and dairy by-products; value for pigs	13
Flatt, C. A. : Breeding and rearing of turkeys	1128
Flax :	
Composition of linseed grown in Scotland	27
Cultivation of	28, 188
Yield of	30

	PAGE
Food and food production (see also <i>Ministry of Agriculture and Fisheries</i> and specific headings):	
Accessory food factors, or vitamins	666
Calories, meaning of	138
Cost of control of food supplies	114
Food production per 100 acres	134
Machinery and implements for	305
National Food Supply	183
Possibility of United Kingdom growing its own food supply	136
Produce (theoretical) from an acre of land	137
Royal Society Committee on Food Supply	183
Transport of produce by aeroplane	421
Work of Food Production Department during 1917-18	135
World's food resources	493
Foot-and-mouth disease, see <i>Diseases of Animals</i> .	
Forestry in Denmark	86
France.	
Agricultural credit in Alsace-Lorraine	183
Agricultural soil maps	57
Livestock for devastated areas	392
Oil cake from	498
Railway Companies and agricultural production	390
Seed cleaning in	981
Wart disease of potatoes in	1076
Francis, P. A.: Education in poultry keeping	753
Fream Memorial Prize	300
Fruit (see also <i>Insects, Fungi and Spraying</i>):	
Apples: Profitable varieties for market	290
Bush trees: pruning demonstration by Ministry	83
Cultivation in a gravel pit	407
Fruit bottling, with or without sugar	566
Fruit trees, consignments to the devastated areas	253
" " for small holdings	413
Gooseberry growing	572
Great Eastern Railway demonstration train	205
Jelly from cider apples	621
Nation's fruit	554
Orchards, renovatio of neglected	602
Pears: profitable for market	760
Preserving	216,512,690
Prospects of crops	401
Sugar for fruit preserving	113
Trees, providing of suitable for small holdings	413
Fungi, &c (see also <i>Spraying</i>):	
Blackchaff	210
Blossom wilt of plums	1142
Brown rot	1144
Bunt in wheat	1013
Control of dry heat	209
Corky scab of potatoes	700,1078
Covered smut of barley	28
Finger and toe	89
Great Eastern Railway demonstration train	205
Loose smut of oats	23
Onion Smut Order, 1920	1170
Potatoes:	
Blackleg	78,956
Blight	215,375,956
" in 1920	1146
Dry rot	1171
Leaf curl	36,287,956
Mosaic disease	956
Wart disease	25,213,299,697,700,733,795,
" Map of infected areas, England and Wales	812,863,890,946
" " Scotland	1174
" Prevalence on the Continent, methods of control	891
" Ministry's action	1074
"	25

Fungi, &c.—continued.		PAGE
Protection of wheat against pests	549	
Quarantine of plants for	26	
Resistance of fungi to heat	210	
Silver leaf of plums	774, 1077	
Spot blotch	210	
Stinking smut of wheat	28, 1018	
Treatment of smut and bunt in corn	378	
Wither tip and brown rot of plums	1142	
<i>Alternaria</i>	210	
<i>Fusarium</i>	210	
<i>Gibberella</i>	210	
<i>Glæosporium</i>	637	
<i>Helminthosporium</i>	210	
<i>Monilia cinerea</i>	1142	
<i>Phytophthora Infestans</i>	864	
<i>Puccinia glumarum</i>	550	
<i>Puccinia graminis</i>	551	
<i>Solanum dulcamara</i>	734	
<i>Solanum Nigrum</i>	734	
<i>Stereum pupureum</i>	774	
<i>Synchytrium endobioticum</i>	733	
<i>Tilletia tritici</i>	1013	
<i>Urocystis Cepulae</i>	1170	
Garrad, G. H. : Poultry keeping in fruit plantations ..	350	
Germany .		
Improvement of grassland in Bavaria	88	
Wart disease of potatoes in	1075	
Goodwin, J. P. : The " Royal's " war record	250	
Gough, G. C. : Insect and fungus pests during the winter	772	
Grain, see <i>Corn</i> , and specific crops.		
Grass, see <i>Pasture</i> .		
Green, Sir J. L. : The establishment of village industries ..	62	
Haenseler, C. M. : Decay in potato clamps due to " black-leg " ...	78	
Hall, Sir A. D. :		
Accounts of a Hampshire flock in 1918-19	126	
History of a grain of wheat from the seed bed to the breakfast table	624	
National food supply	133	
Necessity for production of more wheat	332	
Hammond, J. : Research in egg production	1022	
Harper Adams' Agricultural College .		
Cropping at	100	
Poultry conference	847	
" trials	225	
Hartley, M. Frida : The National Federation of Women's Institutes...	858	
Hay :		
Baling of, on the field	314	
Distribution by county distributing (forage) committees	187	
Firing of hay stacks	1163	
Grading of	187	
Manuring for	47, 48, 118	
Regulations for importation A.	400	
Substitutes for	514	
Holland :		
Export of potatoes to	690, 785	
Wart disease of potatoes in	1074	
Hops :		
Acreage 1918-20	589	
Importation of	787	
Horses, see <i>Livestock</i> . For feeding of horses, see <i>Feeding and Feeding Stuffs</i> .		
Horticulture :		
Appointment of controller	401	
Antwerp; International Friendship Exhibition	399	
Inspection for export—New scale of charges	1175	
Instruction in	410	

Housing	PAGE
Buildings—Adaptation for smallholders	468
Buildings—Equipment of small holdings	111
Buildings—Suggested, for women's institutes	147
Chalk cottages	217
Chalk and cement modern cottage	1010
Compulsory housing on small holdings	813
Concrete cottages	217
Cottage building scheme	216
Cottage restoration and adaptation	780
Denmark Housing on small holdings	174
Housing of labour in Anglesey	174
Pisc de Terre cottages	217
Timber cottages	217
Village halls, erection of	148, 153
Howell, H. G. Farm accounts—profits and costs .	162
Hurst, J. W. Revival of Sussex table poultry industry	984
Implements, see <i>Machinery</i> .	
Import and Export Regulations	
Effect on supplies of basic slag	218
France	
Re-exportation of horses from	498
Export of oil cake from	498
Hay	400
Holland Exportation of seeds to	690, 85
Importation of hops	787
„ Lucerne seed	499
Non-pedigree stock, restrictions on	112
Removal of prohibition on the export of livestock	498
Tunis, Importation of agricultural machinery into ..	787
Insects (see also <i>Spraying</i>)	
Apple capsid	379
Bacterial blight of barley and oats	210
Codling moth	378
Celery fly	377
Flea beetle	88
Gooseberry saw fly	377
Quarantine of plants for	26
Wheat bulb fly in Lucerne	24, 87
<i>Hylemyia Coarctata</i>	24
<i>Lygus Pabulinus</i>	380
<i>Plesiocoris rugicollis</i>	379
Italy Maize cultivation experimental farm, establishment of	598
Jam-making	
Jelly from cider apples	621
When sugar is scarce	512
Jenkin, T. J. Improvement of grass land	1056
Journal of the Ministry of Agriculture	
Alteration in date of publication	401
Errata	300, 590
Supplement on Official Seed Testing Station, 1919-1920 ..	991
Labour (see also <i>Land Settlement of ex-Service Men and Women</i>)	
Arable land, labour for	135
Exodus to towns	152
Housing of labour in Anglesey	174
Pasture land, labour for	135
Pig-keeping and pork production—cost of labour	342
Trade Union influence on an agricultural labourer ..	152
Land	
Areas of, at different altitudes... ..	985
Cultivation, effect on by increased wages	206
Drainage of land	764
Exchange of, under Inclosure and Tithe Acts	290
Onse, drainage of	8, 764
Reclamation by agricultural means	791
Land Settlement of ex-Service Men : \	
Denmark, settlement policy in	53
New South Wales	87

<i>Land Settlement of ex-Service Men—continued.</i>		PAGE
Small holdings allotted to ex-Service men	...	89, 186
Titchfield Farm Settlement	...	186
Training for ex-officers	...	1082
" of ex-soldiers in poultry keeping	...	126
" " ex-Service men at Telscombe	...	1166
Wages	...	219
Wainfleet	...	218
Lee of Fareham, Lord :		
Speech at Rothamsted Experimental Station	...	320
Speech at Leicester	...	816
Lees, A. H. : Reversion of black currants	...	1122
Leaflets issued by the Ministry	193, 298, 497, 690, 786, 984, 1084,	1175
Legislation, see <i>Ministry of Agriculture and Fisheries and Statutory Rules and Orders.</i>		
Lime, see <i>Manures :</i>		
Lincoln tractor trials, 1920	...	714
Lunseed, see <i>Flax.</i>		
Livestock (see also <i>Diseases of Animals, Feeding Stuffs, Import and Export Regulations and Meat</i>).		
Breeding of dairy cattle for milk production	...	647
Bulls, management of	...	178
" grants	...	208
Cattle Breeders' Association of South Africa	...	391
Cattle : The embargo on the importation of Canadian	704, 999, 1085	
Consignment of livestock to devastated areas	...	253, 392
Decontrol of	...	309
Driving of animals at night	...	115
England's first calf club	...	1089
Export of British livestock	...	112
" of decrepit horses	...	709
" removal of prohibition	...	498
Fishmeal as food for	...	414
Grass fattened cattle, numbers of	...	243
Handbook of British breeds	...	313
Horse; suitable for small holder	...	418
Horses; London Thoroughbred Stallion Show, 1921	...	815
" re-exportation of, from France	...	498
" licences, application for under Horse Breeding Act	...	785
Humane slaughter of animals	...	707
Keeping of, by allotment holders and householders	...	710
Licences : Notice to stallion owners	...	1174
Lime, necessity for bone and milk production	...	75
Livestock on Danish small holding	...	54
Mole, life history of common	...	659
Mountain pony, its value to agriculture	...	308
Pigs :		
Grants for boars	...	17, 208
Industry, need for increased production	...	16
Insurance clubs	...	17
Open air shelters for	...	105
" " management	...	124
As food producers	...	134
Open air keeping	...	456
Poisoning by yew	...	810
Rabbit keeping at public institutions	...	463
" experiments by R. C. Punnett	...	573
Scheme of Ministry	...	208
Sheep :		
Cost of keeping during summer months	...	127
" ewes and lambs per annum	...	126
Decline in breeding	...	450
Hampshire flock, account of	...	126
Decrease in numbers kept	...	129
Small livestock : Experiments in chickens and rabbits	...	873
Store cattle—the case against imports	...	4085
Stallions : Super, King's and Ministry's—names and routes	193, 815	
" licensing of	...	749
" production of licences for	...	313, 419

	PAGE
<i>Livestock—continued.</i>	
Tethering of, in pastures (Denmark) . . .	55
Udder stocking of cows . . .	316
Valuation of . . .	126, 127, 165
Value of non-pedigree stock . . .	113
Lloyd, F. J. British Dairy Farmers' Association	640
<i>Lucerne :</i>	
Growth on breckland . . .	124
Wheat bulb fly . . .	24, 87
Quarantine of plants for . . .	26
Luxembourg : Wart disease of potatoes in	1076
<i>Machinery</i>	
Agricultural Machinery Committee Report . .	1, 91, 187
Agricultural machinery, free entry into Tunis . .	787
Cost of production . . .	8
Education in . . .	108
Future of . . .	1
Machinery and implements for food production	305
Milking machines . . .	506
New duties on agricultural vehicles . . .	115, 194
Research, Institute of . . .	109
Road grader (case), use of . . .	10
Standardisation of . . .	204
Tractors, use of . . .	9, 123
" trials, 1920 . . .	20, 714
Threshing machines, repair and maintenance . .	973
United States Farm power conference at Chicago . .	202
Mackintosh, J. Breeding dairy cattle for milk production .	647
<i>Mangolds</i>	
Harvesting of . . .	559
Manuring for . . .	38, 41, 46, 48, 116, 157, 877
Mansel, Miss M. B. Dorset Arts and Crafts Association .	769
Mansfield, Wilfred S. The harvesting of mangolds . . .	559
Manures (see also " Notes on Manures," published periodically in this <i>Journal</i> and not separately indexed as such)	
Ammonium carbonate . . .	1043
" chloride . . .	1043
Basic slag . . .	38, 61, 98, 117, 123, 218, 241, 245, 297, 611, 617, 683, 688, 880
Bone meal . . .	880
Bracken, eradication of . . .	111
Cabbages, manuring of . . .	39
Cereals, manuring of . . .	41, 46, 47
Chalking and liming . . .	5, 10, 77, 117, 123, 157
Cyanamide, see <i>Nitrolim</i> . . .	1043
Farmyard manure . . .	35, 37, 38, 54, 116, 117, 444, 685
Fertilisers, imports and exports of . . .	34
" synthetic nitrogenous . . .	1037
Grassland, manuring for . . .	42, 371, 1056
Hay, manuring for . . .	47, 48, 118
Kainit . . .	38, 39, 40, 41, 42, 684
Leather as manure . . .	879
Leguminous crops, manuring for . . .	42
Liming and chalking, see <i>Chalking and liming</i> . .	882
Magnesium salts . . .	877
Mangolds, manuring for . . .	38, 41, 46, 48, 116, 157, 877
Manurial values of various farm foods . . .	190
Marl (Denmark) . . .	86
Mineral phosphates for moorland . . .	611
Nitrate of ammonia . . .	1041
" lime . . .	43, 44, 45, 46, 47, 48, 116, 1038
" soda . . .	38, 39, 47, 48, 116, 685, 1041, 1038
Nitrogen production from air . . .	417
Nitrolim . . .	47, 48, 1043, 1153
Potash salts . . .	40, 41, 42
Applied to breckland . . .	123
Comparison of fertilising value\ . . .	40
On grassland . . .	877
Purchase of . . .	42

INDEX

xv

Ministry of Agriculture and Fisheries—continued.	PAGE
Live stock scheme	208
Map inspection facilities	224
Ministry of Agriculture and Fisheries Act, 1919	8,148
Model allotment at Ideal Home Exhibition	81
Offices, Ministry's new	989
Onion Smut Order, 1920	1170
Potato clamps, decay in, investigations by Ministry	78
Potato trials in East Sussex by Ministry	211
Poultry :	
Policy of Ministry	19
Ministry's scheme	106
Instruction in, for ex-soldiers	126
Rat destruction	221
" " research laboratory	222
Report on Ministry's work on diseases of animals, 1919	806
" Royal " Show pavilion	304
Seeds Act, 1920	604
Speech by Minister at Leicester	516
Speech by Minister at Rothamsted	320
Testing of Seeds Order, 1918—Administration	797
Testing of Seeds; Official testing 1919—1920	991
Tithe Acts; exchanges of land	220
Tobacco; demonstration in growth by Ministry	6,124
Trade Union Congress Deputation	1148
Wart disease of potatoes, action of Ministry	25
Wages; deputation to Minister	218
Woman adviser	409
Moorland pasture :	
Improvement of	610
Grazing, improvement of	928
Mushroom, commercial cultivation of	678
New South Wales. Land settlement in	87
Newman, L. F.: Feeding experiments with dried blood	266
Norfolk	
Demonstration farm in	3
Farming of breckland in	122
Norway. Wart disease of potatoes in	1076
Northern Utility Poultry Society. Egg laying competition	19
Notices of Books :	
Animal foodstuffs: their production and composition	90
British Dairy Farmers' Association	393
Co-operation in Denmark	188
Cottage building in cob, pisé, chalk and clay	1083
Course of practical chemistry for agricultural students	90
Crop production, the chemistry of	1083
Electrification of seeds by Wolfryn process	495
First report of the Departmental Committee on the wholesale food markets of London	188
Flax culture and preparation	188
Forest management	1177
Forest products, their management and use	1176
Gloucestershire Cattle Society	393
Insect pest and fungus diseases	686
International Year Book of agricultural legislation	1084
Modern pig feeding	686
National Council of social service	590
Ordnance survey maps	90,687
Preservation of fruit and vegetables	1083
Report of Departmental Committee on agricultural machinery	91
Report of the Tropical Agricultural College Committee	189
Small farm and its management	495
Village clubs and halls	90
Women's institutes	206
World's food resources	498
Oats :	
Bacterial blight	210
Cultivation of	599

	PAGE
Oats—continued.	
Oats for green food	99
Varieties, used on Cornish moor	10
Yield, in Cornwall	10
" Cockle Park and Aberdeen	47
Winter oats	599
Oldershaw, A. W. :	
Preserving green fodder : an inexpensive trench silo	65
Pit, trench and other improvised silos	1046, 1173
Orchards : Renovation of neglected	602
Ordnance Survey Maps :	90
Report of progress, 1919-20	687
Ormskirk : Potato trials	497, 697, 891
Ouse : Drainage operations	8, 764
Owen, B. J. . Notes on Lincoln tractor trials, 1920	714
Oxford : Rural economy at	272
Paine, S. G. : Decay in potato clamps due to Black-leg	78
Parker, W. H. : Forage crops of Denmark	364
Parliament : Questions in :	
Advances to tenants of small holdings	296
Agriculture Bill	185, 397
" Councils of	396
" Committees	186
" Societies	398
Agricultural Organisation Society	397
" Rates Act	187
" Wages	186
Allotments	887
Arable cultivation	886
Calf breeding	397
Exported horses . standard of fitness	887
Farm colonies	887
Farming operations by Agricultural Executive Committees	591
Farms entered on by Agricultural Executive Committees	296
Foot and Mouth Disease	187, 394, 496, 886
Forage; County Distributing Committee	187
Hay; grading and distribution of	187
Hay and Straw Department, War Office	397
Land cultivation and increased wages	296
Land settlement	89, 186, 886
Machinery	187
Meat; quantities imported and home grown, consumed in pre-	
War years	296
Milk prices in Wiltshire	496
Muzzling Order	89
Pig-keeping	394
Potato spraying	496
Sheep Dipping Order	591
Small holdings, number of	592
Small holdings and allotments (notices to quit)	591
Stallions, King's premiums for	397
Sugar, home grown	396
Tenure of allotments	496
Tillage	89
Titchfield Farm Settlement	186
Tuberculosis Order of 1913	89
Wheat :	
Home grown	185
Ploughing up of winter	89
Prices	185, 394, 698
Production	686
Spring	185
Pasture :	
Acreage	134, 242
Acid conditions: effect on	74
Contrast with arable	134
Diseases of grasses	697
Example of excellent	242

Pasture—continued.		Page
Grasses and clovers of Denmark	...	366
Improvement of	...	244, 369, 610
" grass land and the importance of experiments	...	1066
" in Bavaria	...	88
" of rough pasture	...	1066
Moor, cultivation of, in Cornwall	...	9
Moorland grazing	...	928
Moorland, mineral phosphate for	...	611
Difference in labour required—pasture v arable	...	135
Stock-farmer's point of view	...	245
Perennial rye grass and wild white clover	...	674
Plant breeding at Aberystwyth	...	634, 739.
Productiveness of new arable	...	4
Seed growing in Great Britain	...	535
Seeds Act, 1920	...	604
Temporary leys, mixture for	...	100
Wild white clover, value for	...	60, 101
<i>Avena strigosa</i>	...	745
" <i>sterilis</i>	...	746
" <i>saliva</i>	...	746
<i>Andropogon halepensis</i>	...	636
" <i>sorghumcar</i>	...	636
<i>Chloris gayana</i>	...	636
<i>Cicer arretinum</i>	...	636
<i>Hedysarum coronarium</i>	...	636
<i>Trifolium alexandrinum</i>	...	636
<i>Danthonia pilosa</i>	...	635
<i>Eragrostis abyssinica</i>	...	635
<i>Phalaris nodosa</i>	...	635
<i>Trifolium subterraneum</i>	...	634
<i>Vicia villosa</i>	...	635
Peas		
Green food	...	90
Yield on breckland	...	123
Petherbridge, F. R.: Potato spraying trials in the Cambridgeshire Fens, 1919	...	282
Pigs, see <i>Livestock</i> . For feeding of pigs see <i>Feeding and Feeding Stuffs</i>		
Plant, breeding at Aberystwyth	...	631, 739
Porter, John: Liming in Herefordshire	...	157
Potash (see <i>Manures</i>).		
Potatoes (see also <i>Fungi and Spraying</i>).		
Acreage	...	242
Berry	...	142
Boxing	...	36
Composition of, immune from wart disease	...	49
Control	...	22, 954
Cooking properties	...	213
Cross fertilisation	...	138, 139
Cumberland and Westmorland as nurseries	...	794
Demonstration plots	...	311, 958
Disease (blight) in 1920	...	1146
Early planting in wart disease infected areas	...	416
Export to Holland	...	690, 785
Flower, description, sterilisation and fertilisation	...	138, 139, 141
Importation into Ireland	...	811
Importation of seed potatoes from Scotland	...	785, 959
Increased production, need of	...	85
Inspection of crops, 1920	...	954
Leaf curl; causes and control	...	237
Losses in clamps; prevention of	...	80
Planting of early, in wart disease infected areas	...	416
" susceptible varieties in wart disease infected areas	...	700
Potato clamps, decay in	...	78
Scotch seed, advantages of	...	212
Seaweed, as manure for	...	92
Seed potatoes	...	183

Potatoes— <i>continued</i>	Page
Seed potatoes, English and Welsh, importation into Scotland	1082
Seeds Act, 1920	604
Trials in Cambridgeshire fens, 1919	282
" " East Sussex	211
" " Ormskirk	497, 697, 891
Usefulness of	85
Uselessness of seed dressings for blight	215
Varieties	211, 214
Winter storage	619
Yield on breck land	128
Poultry (for feeding of Poultry see <i>Feeding and Feeding Stuffs</i>).	
Chicken experiment by Prof R C Punnett	378
" rearing, cost of	1159
Denmark, egg prices	55
Distribution of sittings of eggs and day old chicks	854
Economic position of the industry	458
Education in poultry keeping	757, 847
Egg Prices Order	890
" laying competition, Northern Utility Poultry Society	19
" " test at Dodnash Priory	970
" production, research in	1022
" " high productivity essential	1035
Eggs (Description on Sale) Order, 1920	1082
" Imports	17
" number in egg laying competition	20
Harper Adams Agricultural College laying trials	225
" " annual poultry conference	847
Improvement in keeping	516
Keeping	
Combined with market gardening	412
In Cornish school	517
In fruit plantations	350
On stubbles	615
Ministry's scheme of instruction	106, 124
Notes on keeping	967, 1157
Policy of Ministry	19
Shell (Slipper limpet grit) for poultry	1033
Stubble feeding	615
Sussex table poultry industry, revival of	934
Turkeys, breeding and rearing	1128
Value of hens with high egg yield in towns	18
Winter egg production	613
" feeding	612
World's congress	971
Prices	
Agricultural	607
Basic slag, 1920-1921	296
Boars	225
Cheese making returns	104
Chick food	226
Eggs	225, 1157
" prices in Denmark	55
Food control, cost of	116
Feeding costs of poultry (per bird)	225
Grain standard	197
Manures	296, 399
Maize, maize meal and oats as food	225
Mutton, before war and present day	129
Non pedigree stock	118
Oats	225
Sheep	
Price of ewe	126
" ram	127
Sale of rams	128
Use of rams	128
Sharps	225
Sulphate of ammonia, 1920-1921	399, 1174

Prices—continued	PAGE
Sugar for bee keeping ..	93
" " fruit preserving ...	114
Wheat ... 185,225,394,895,988,1091,1097	
Wild white clover seed ...	61
Prosecution, for travelling an unlicensed stallion ...	419
Funnett, E C : Chickens and rabbits, experiments of ...	373
Railway rates and agriculture ...	617, 812
" " forage ...	100
Rats	
Baits ...	223
Clubs Research Institute ...	222
Destruction ...	221, 316, 422
" by Government aid ...	1052
Grassing ...	223
National rat week ...	712
Head, E C . Rat destruction by Government aid ...	1052
Reclamation, see <i>Drainage and Waste Land</i> .	
Reports .	
Agricultural Machinery Committee report .	1
Development Commissioners, Tenth report ..	1088
Diseases of Animals Act, 1919 ...	806
Official seed testing station, 1919-20 ...	291
Ordnance Survey, report of progress, 1919-20 .	687
Research	
Agricultural research administration ...	301
Disease of cattle ..	644
Egg production .	1022
Institute .	109
Scholarships .	303, 984
Rew, Sir R H	
Decline in sheep breeding .	450
Social service in rural areas ..	745
Richardson, H G Lincoln tractor trials, 1920	714
Rothamsted Experimental Station	
Barley, field trials .	47
Extension of laboratories ..	891
Lawes Agricultural Trust Committee Appointment of chairman	891
Memoirs on agricultural science, 1909 16	687
Woburn experimental fruit farm, closing of .	891
Rural industries, development of ..	621
Ruston, A G	
Air pollution by coal smoke ...	69
Pig feeding and the cost of pork production ..	240
Russell, E J	
Synthetic nitrogenous fertilisers .	1037
The improvement of peaty soils, Part I	1104
Salaman, Redcliffe N . Technique of cross fertilisation of potatoes	138
Salmon, E S Prevention of "bunt" in wheat ...	1013
Scotland, composition of linseed grown in ...	27
Seeds (for seed potatoes, see <i>Potatoes</i>)	
Administration of the Testing of Seeds Order, 1918 ...	797
Denmark, seed trade of ...	307
Disease carried by cereals; control by dry heat ...	209
Grass seed mixtures and temporary leys ...	100, 370
Importance of sowing clean seed (wheat) ...	113
Official seed testing station, 1919-20, report of ...	991
Purchase of .	796
Sale of cereal seed ..	688
Seed cleaning in France ...	981
" , grass and clover, growing in Great Britain ...	535
Seeds Act, 1920 ...	604
Wild white clover seed; trials and prices ...	60, 61
Wolfryn process ...	495
Selborne, Rt Hon Earl of . The new farming landowner ..	1099
Sevington, basic slag experiments at ...	98
Sheep grazing on slagged meadows .	98
Shows (see <i>Exhibitions and Shows</i>) .	
Advantages of agricultural .	199

						PAGE
Silage :						
Composition of	...	...	...	...	...	68
Cost of silo	...	...	...	...	...	65
Mabens' method of preparation in trenches	...	...	...	...	...	65
Preparation in trenches	...	...	...	...	...	66, 67
" of	...	...	...	...	...	66
Pit, trench and other improved silos	...	...	...	...	...	1046, 1173
Small Holdings and Allotments. For settlement of soldiers on small holdings see <i>Land Settlement for ex-Service Men</i> :						
Allotment movement in England and Wales	...	...	...	...	...	262
Advances to tenants	...	...	...	...	...	296
Co-operative farming on	...	...	...	...	...	1165
" movement since the War	...	...	...	...	...	435
Committee	...	...	...	...	...	111
Compulsory housing	...	...	...	...	...	813
Denmark, housing on small holdings in	...	...	...	...	...	52, 172, 174
Equipment of	...	...	...	...	...	110, 802
Fruit trees for small holdings	...	...	...	...	...	413
Experiments in adaptation for small holders	...	...	...	...	...	468
Ministry's model allotment	...	...	...	...	...	81
Numbers of	...	...	...	...	...	82, 201
Rumania, small holdings in	...	...	...	...	...	982
Smith, Kenneth M. : The injurious apple capsid	...	...	...	...	...	379
Smithfield Club and its history	...	...	...	...	...	799
Soiling crops and general farming	...	...	...	...	...	725
Soils :						
Carr (peaty)	...	...	...	...	...	1107
Treatment of different types of	...	...	...	...	...	598
The improvement of peaty	...	...	...	...	...	1104
South Africa, Cattle Breeders' Association of	...	...	...	...	...	391
Spraying :						
Bordeaux mixture	...	...	...	...	...	215
Burgundy mixture	...	...	...	...	...	215
Destruction of charlock	...	...	...	...	...	622
Early	...	...	...	...	...	215
Failure of	...	...	...	...	...	212
Potato spraying experiments in Cambridgeshire fens	...	...	...	...	...	262
Stapledon, R. G. : Plant breeding work at Aberystwyth	...	...	...	...	...	630, 739
Statutory Rules and Orders .						
Agriculture Bill	...	...	...	...	...	185, 197
Agricultural Rates Act	...	...	...	...	...	187
Cultivation of Lands Order	...	...	...	...	...	93
Egg Prices Order, 1920	...	...	...	...	...	990
Eggs (Description on Sale) Order, 1920	...	...	...	...	...	1082
Lights (Driving of Animals) Order, 1916, re-imposed	...	...	...	...	...	115
Milk Order, 1920	...	...	...	...	...	15
Ministry of Agriculture and Fisheries Act	...	...	...	...	...	8, 148
Muzzling Order	...	...	...	...	...	89
Onion Smut Order, 1920	...	...	...	...	...	1170
Poultry and Egg Prices Order, 1919	...	...	...	...	...	99
" " Game (Prices) Order, 1918	...	...	...	...	...	93
Rats and Mice (Destruction) Act	...	...	...	...	...	223
Seed Potatoes Order, 1918	...	...	...	...	...	23
Silver Leaf Order, 1919	...	...	...	...	...	1077
Tuberculosis Order, 1913	...	...	...	...	...	89
Stoddart, J. : Tomato culture	...	...	...	...	...	360
Straw, importation regulations	...	...	...	...	...	400
Sugar :						
Fruit preserving; allotment by Ministry	...	...	...	...	...	113
Prices	...	...	...	...	...	114
" for bee-keeping	...	...	...	...	...	93
Sugar beet :						
Factories	...	...	...	...	...	92
Growing in England	...	...	...	...	...	92
Manuring for	...	...	...	...	...	117
Sulphate of ammonia, see <i>Manures</i>.	...	...	...	...	...
Superphosphate, see <i>Manures</i>.	...	...	...	...	...
Sweden : Wart disease of potatoes in	...	...	...	...	...	1076

	PAGE
Switzerland : Firing of haystacks	1188
Taylor, H. V. : The distribution of wart disease	783,863 947
Tebbutt, Lieut.-Col. Louis : French agricultural soil maps	57
Telcombe, training of ex-Service men at	1166
Tenancies, determination of	438
Thompson, Capt. Anthony : Moorland grazing	928
Titchfield farm settlement	186
Tithe :	
Ecclesiastical Tithe Rentcharge (Rates) Act, 1920	592
Exchanges of lands	220
Rentcharge redemption	386,984
New basis for redemption	1081
Tobacco :	
Demonstration of growth by Ministry	6,124
Growing in England	522
Tomatoes :	
Culture of	360
" Damping off " of seedlings	670
Transport :	
Agricultural vehicles, new duties on	116
Food produce by aeroplane	421
Lights (Driving of Animals) Order, 1916	115
" when driving animals at night	115
Ministry of Transport Committee	115
Taxation and regulations of road vehicles	115
United States :	
Cinema as an aid to agriculture	778
Farm power conference at Chicago	202
Farmers' week in Missouri	181
Keeping farm accounts	1161
Vegetables :	
Field roguing of English peas	1167
Nation's vegetables	554
Winter storing	619
Yield on breck-land	123
Vetches, for green food	99
Village bulbs associations :	147
Compton	28
Conference	800
Basket production	62,63
County councils and	
Establishment of village industries	62
Halls available for village clubs, number of	149
Ideal village institute	153
Manufacture of toys, fancy leather goods, etc.	68
Rural department of council of social service	150
Social service in rural industries	155
State-aid for village institutes	154
Village institutes as an aid to rural education	152
Women's institutes and	64,206,207
Wages :	
Agricultural workers, during and since the War	609
Deputation to Minister	218
Effect on cultivation of land	236
Enforcement of Orders	526
Ex-Service men	219
Harvest wages	537
Minimum rates, proposed increase	422,537
Report of the Board's committee on cottages	712
Wales :	
Education in	176
Housing of agricultural labourers in Anglesey	174
Rural conditions : comparison with Denmark	173
Weather forecasts for farmers	192
" " 1798-1915	280
War :	
Agricultural conditions, 1914-1918	286

War—continued.	Page
British Dairy Farmers' Association, work during	645
Comparison of origin with that of Napoleonic War	237
Effect of sheep breeding	450
Financial position at outbreak of the two great wars, 1798-1815 and 1914-18	237
Population in 1798 and in 1914	237
Taxation and the National Debt	238
Waste Land:	
Reclamation by agricultural means	791
" of heath land in Denmark	85
" at Wainfleet	218
Watercourses, improvement of	764
Watkin, Gertrude Agriculture as an occupation for women	1080
Weaving, hand loom	561
Weeds.	
Bracken, eradication of	111
Charlock, destruction of	622
Wheat	
Acreage	262
" in 1872 contrasted with 1914	184
British prices	895, 698
Campaign for increased production	943
Continuous growing	501
Crop, 1921, necessity to grow more wheat	424
Cultivation, climate, soils and varieties	597
From seed bed to breakfast table	624
Home-grown	185, 424
Prices	693, 895, 1091, 1097
Production and imports, 1909-18 and 1918	332
" necessity for more	333
Protection against fungus pests	548
Sowing	504
Spring wheat	185
Trials of new varieties	694
Winter wheat, early sowing	405
" " ploughing of	89
Yield on brack-land	128
Wilkes, J. F. The modern cottage of chalk and cement	1010
Williams-Ellis, Clough. The modern cottage Experiments in Pisé at Amesbury	539
Woburn; experimental fruit farm, closing of	891
Wolfryn process of treatment of seeds for increased yields	495
Women.	
Adviser	409
Agriculture as an occupation for	1080
Small holdings in Denmark	53
Women in horticulture	1187
Women's institutes	
Agricultural education, and	940
Buildings for	147
Progress of	206
Schools for organisers	600
The National Federation of	358
Wormald, H. Prevention of bunt in wheat	1018
Wyllie, James: Profit and loss sharing in agriculture	254
Yew tree poisoning (<i>Taxus baccata</i>)	810

